SAE Journal

DECEMBER 1954

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Published by The Society of Automotive Engineers

DID YOU KNOW

that in a car's engine...

TEMPERATURE *during combustion reaches as much as 3 times the heat of molten lava?*

PRESSURE *in combustion chambers can be twice as great as water pressure at 100 fathoms?*

LUBRICATION *of cylinder walls may depend on an oil film only 1/10 as thick as a spider web?*

Only chrome plated piston rings can take this punishment without excessive wear!

*

The application of solid chrome plating to piston rings, as perfected by Perfect Circle, more than doubles the life of pistons, cylinders and rings. Complete performance data will be sent upon request. The Perfect Circle Corporation, Hagerstown, Indiana; The Perfect Circle Company, Ltd., Toronto, Ontario.

The advantages of chrome plated piston rings in this area of intense heat, highest pressure and poorest lubrication have been recognized by automotive engineers everywhere ...and 34 out of 36 ENGINE MANUFACTURERS USING CHROME RINGS SPECIFY PERFECT CIRCLE.

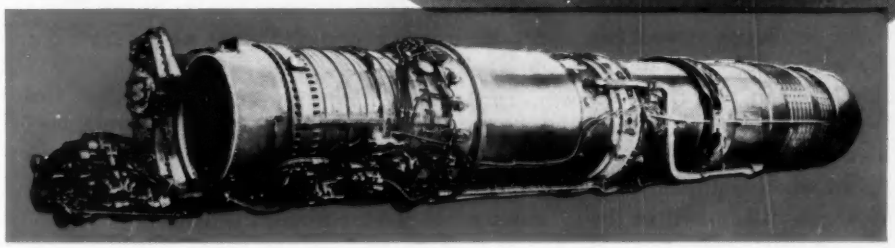
For complete chrome protection...for thousands of extra miles of sustained power and lasting oil economy, always specify

Perfect Circle

chrome piston rings

The Standard of Comparison

127 New Departures Join the Navy!



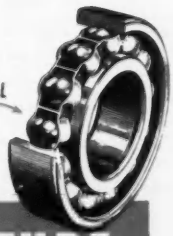
Westinghouse J-40 jet engine with Exhaust Nozzle Actuator Control for the afterburner, where 127 New Departure instrument **ball** bearings contribute extreme precision and efficiency.

Design by Douglas . . . power by Westinghouse . . . precision by New Departure. That's the Navy's F4D SKYRAY jet—first carrier-based plane to hold the world speed record—753.4 mph.

Among other applications in the SKYRAY, there are 127 New Departure precision instrument **ball** bearings in its Westinghouse Exhaust Nozzle Actuator Control. This control maintains proper engine temperatures, and demands the utmost in bearing accuracy and efficiency. New Departures meet these demands.

Throughout defense and industry, you'll find New Departures making *good* products even *better*. Learn how these fine **ball** bearings can help *your* design . . . talk with your New Departure engineer *today!*

NOTHING ROLLS LIKE A BALL



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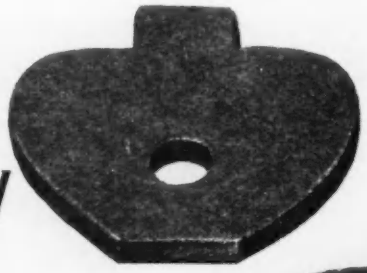
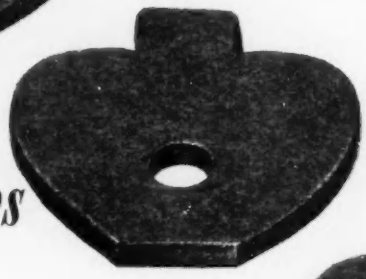
BALL BEARINGS

NEW DEPARTURE • DIVISION OF GENERAL MOTORS • BRISTOL, CONNECTICUT
Plants also in Meriden, Connecticut, and Sandusky, Ohio
In Canada: McKinnon Industries, Ltd., St. Catharines, Ontario

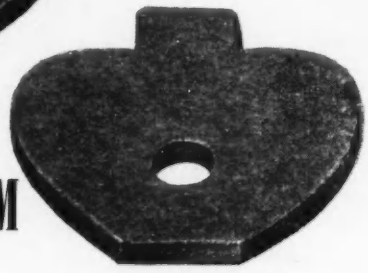
A Hundred



or a MILLION pieces



...always UNIFORM



Cut to *Your* Precision Demands!

When Western Felt cuts a component part to your specifications, piece after piece is a precision-cut part. You want that kind of uniform precision because the performance of *your* product depends upon it. And because of the peculiar properties of wool felt fibres, especially where the more dense types are specified, it can be processed with amazingly close tolerances. Tolerances as close as a few-thousandths of an inch can be supplied when required.

Western Felts are manufactured to the density you require—cut and supplied exactly to your specifications. They resist wear, age and weather...never ravel nor fray. They seal, insulate, absorb sound and vibration, or lubricate...as you wish! Chemically treated, they can be moth-proof, mildew-proof, flame or water resistant.

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Manufacturers and Cutters of Wool Felt

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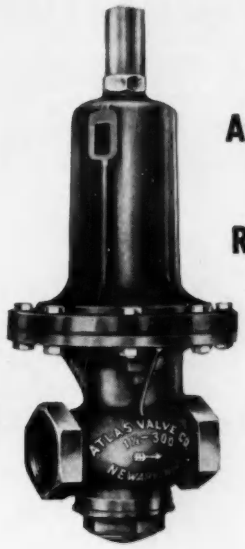
sealed **TIGHT,**
sealed **RIGHT,**
with a **Precision "O" Ring!**

. . . this Atlas Reducing Valve

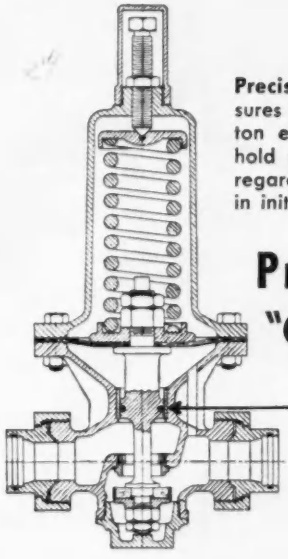


Atlas Fig. 191—Type "E" Reducing Valve

The Atlas Valve Co., Newark, N. J., has developed its Fig. 191-Type "E" Reducing Valve for initial pressures to 300 PSI, and reduced pressures from 5 to 125 PSI, on water, air or oil service. For a positive seal on the piston—less friction, better and longer service life at higher temperatures — Atlas Engineers specify **Precision** "O" Rings.

How about your sealing problem? Let our engineers help you solve it with **Precision** "O" Rings—tough, compression molded, rigidly inspected—finest "O" Rings made!

FREE—Handbook of "O" Ring data.
Write for yours today.



Precision "O" Ring assures tight seal on piston enabling valve to hold reduced pressure regardless of changes in initial pressure.

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UNIT OF NATIONAL STEEL CORPORATION

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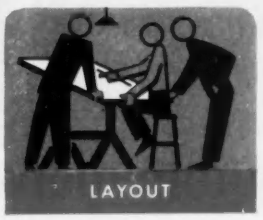
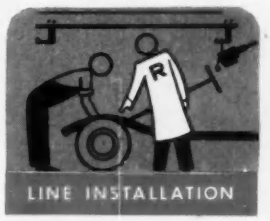
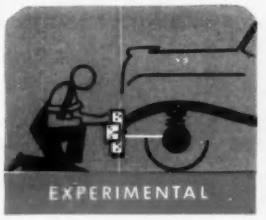
What's YOUR Steering Problem?







▶ **Your attention** is invited to the five small sketches at right . . .

▶ **They suggest** helpful steps in the solution of a typical steering problem. And they further make the important point that *good* steering is *much more* than a steering gear.

▶ **For 48 years** Ross has *specialized* in steering research, engineering, design and manufacture. The experience thus gained is dedicated to *one* purpose—to help solve *your* steering problems.

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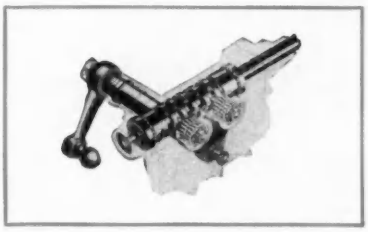
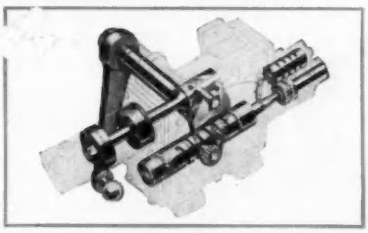
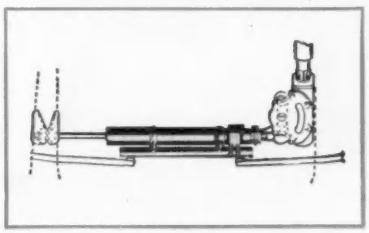
Ross **STEERING**







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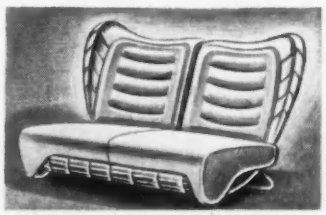
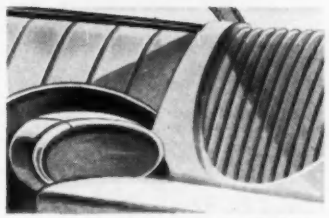


Exciting new seating ideas become practical with AIRFOAM!



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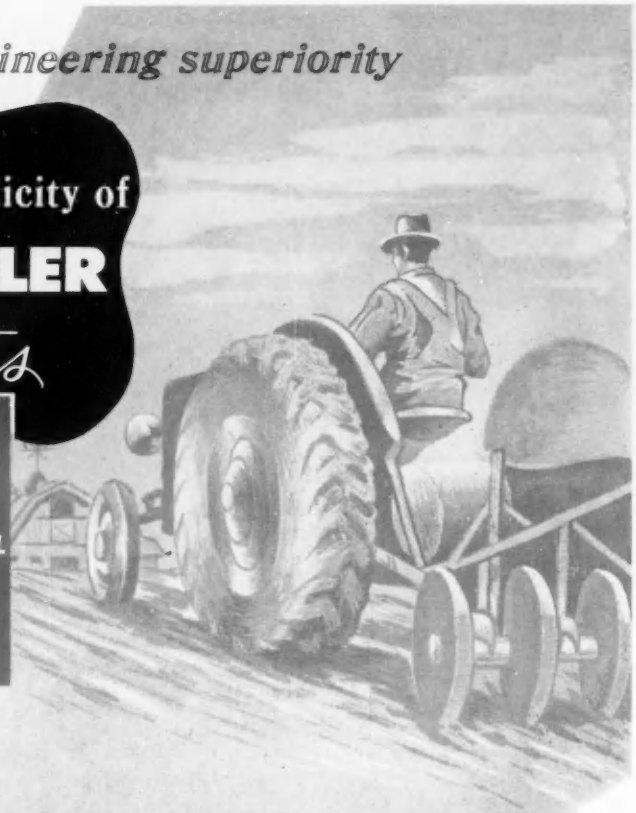
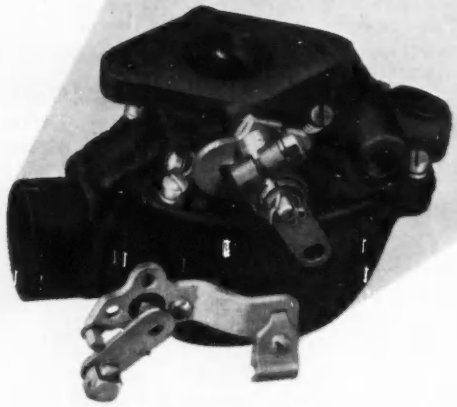
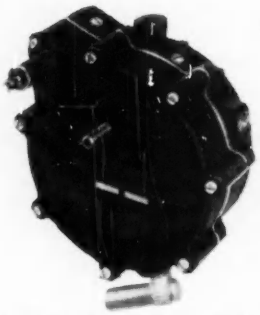


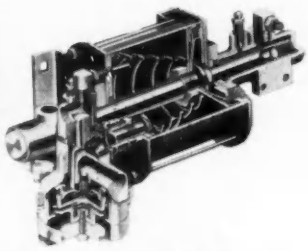
Product acceptance lies in the precision engineering and simplicity of design inherent in these products. Marvel-Schebler has achieved this acceptance only through years of experience in the development and production of carburetion systems. If you're looking for a carbureter that will save production costs, yet provide long trouble-free operation, let Marvel-Schebler quote on a carbureter for your next design.



Gasoline Carbureters for Tractors, Industrial and Aircraft Engines



LP Gas Carbureter Systems for Trucks Tractors and Industrial Engines



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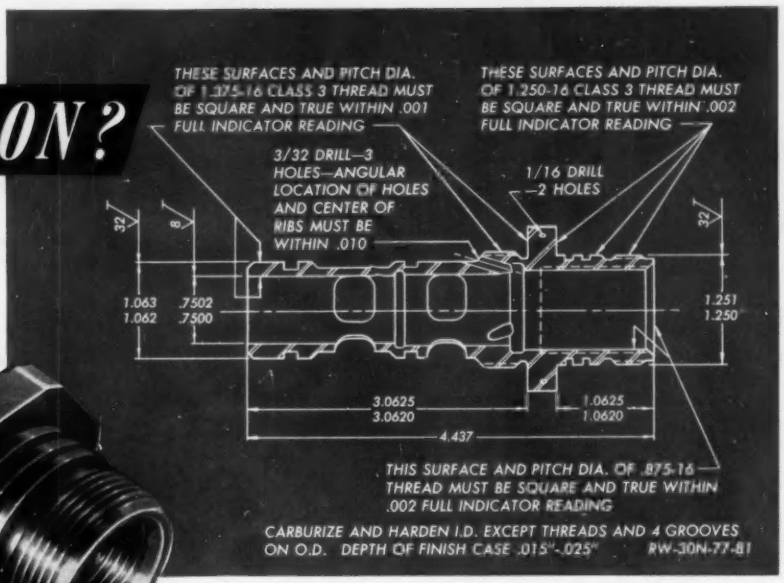
PRECISION?


THESE SURFACES AND PITCH DIA. OF 1.375-16 CLASS 3 THREAD MUST BE SQUARE AND TRUE WITHIN .001 FULL INDICATOR READING
THESE SURFACES AND PITCH DIA. OF 1.250-16 CLASS 3 THREAD MUST BE SQUARE AND TRUE WITHIN .002 FULL INDICATOR READING
3/32 DRILL—3 HOLES—ANGULAR LOCATION OF HOLES AND CENTER OF RIBS MUST BE WITHIN .010
1/16 DRILL —2 HOLES
32
8
32
1.063
1.062
.7502
.7500
1.251
1.250
3.0625
3.0620
1.0625
1.0620
4.437
THIS SURFACE AND PITCH DIA. OF .875-16 THREAD MUST BE SQUARE AND TRUE WITHIN .002 FULL INDICATOR READING
CARBURIZE AND HARDEN I.D. EXCEPT THREADS AND 4 GROOVES ON O.D. DEPTH OF FINISH CASE .015"-.025"
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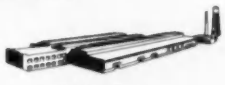
PLANT 2
Detroit, Mich.

PLANT 3
Hillsdale, Mich.



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THE PROOF IS IN THE PACKAGES!

Rohr has won fame for becoming the world's largest producer of ready-to-install power packages for airplanes – like the Lockheed Constellation, Douglas DC-7, the all-jet Boeing B-52 and other great military and commercial planes.

This, we believe, is proof of Rohr's engineering skill and production know-how. But it's not the whole story.

Currently, Rohr Aircraftsmen are producing over 25,000 different parts for aircraft of all kinds... many of these calling for highly specialized skill and specially engineered equipment.

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AC was first to tackle the job of quieting them down, with the introduction of the original resonating-type carburetor intake silencer. That was 1930 and a big change was under way. With intake noises hushed, owners (and automobile engineers, too!) became more conscious and critical of other engine noise. An era of quiet was ushered in.

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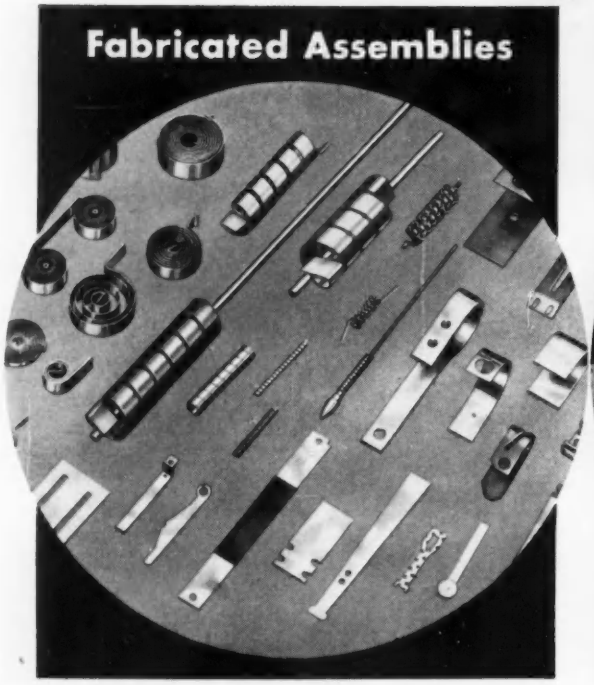
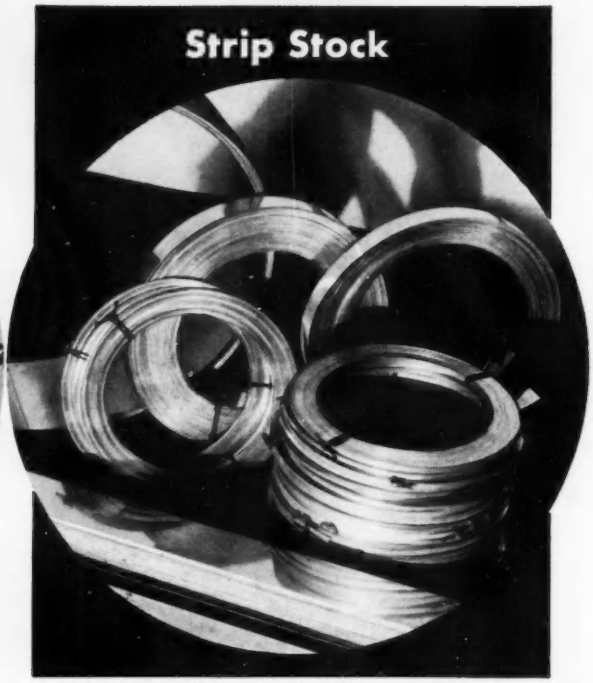
AC SPARK PLUG DIVISION GM GENERAL MOTORS CORPORATION

In Any Form





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Give Accurate Temperature Response . . . Cut Costs

General Plate *Truflex* Thermostat Metals provide a sure way to get reliable performance and at the same time cut costs of products requiring temperature control, indication or compensation.

Advanced General Plate production methods coupled with the best equipment available insure close tolerances on all properties and dimensions. This maintains positive consistency in thermal, mechanical, and electrical performance. With no variation from lot to lot rejects are eliminated, costly adjustments are minimized.

General Plate *Truflex* fabricated assemblies are engineered and manufactured to your specifications, ready for installation into your products. They eliminate costly fabrication problems . . . needless special equipment . . . experimental work and expensive calibration.

However, if you prefer to make your own assemblies, General Plate *Truflex* Thermostat Metals are available as strip in extra long coils or flat cut lengths manufactured to your material specifications.

Write for information and engineering assistance.

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For the Sake of Argument

Personal Decisions . . .

By Norman G. Shidle

The decisions we make can pretty much determine the course of our lives. That's especially true if we happen to think of "life" as consciousness or sense of being, rather than as a series of events.

We can't always control what happens to us. But we can control what we think about what happens. . . . And what we are thinking *is* our "life" at any particular moment.

Faced with a given event or fact, we decide for ourselves whether it is an opportunity or a roadblock; can be made a help or a hindrance.

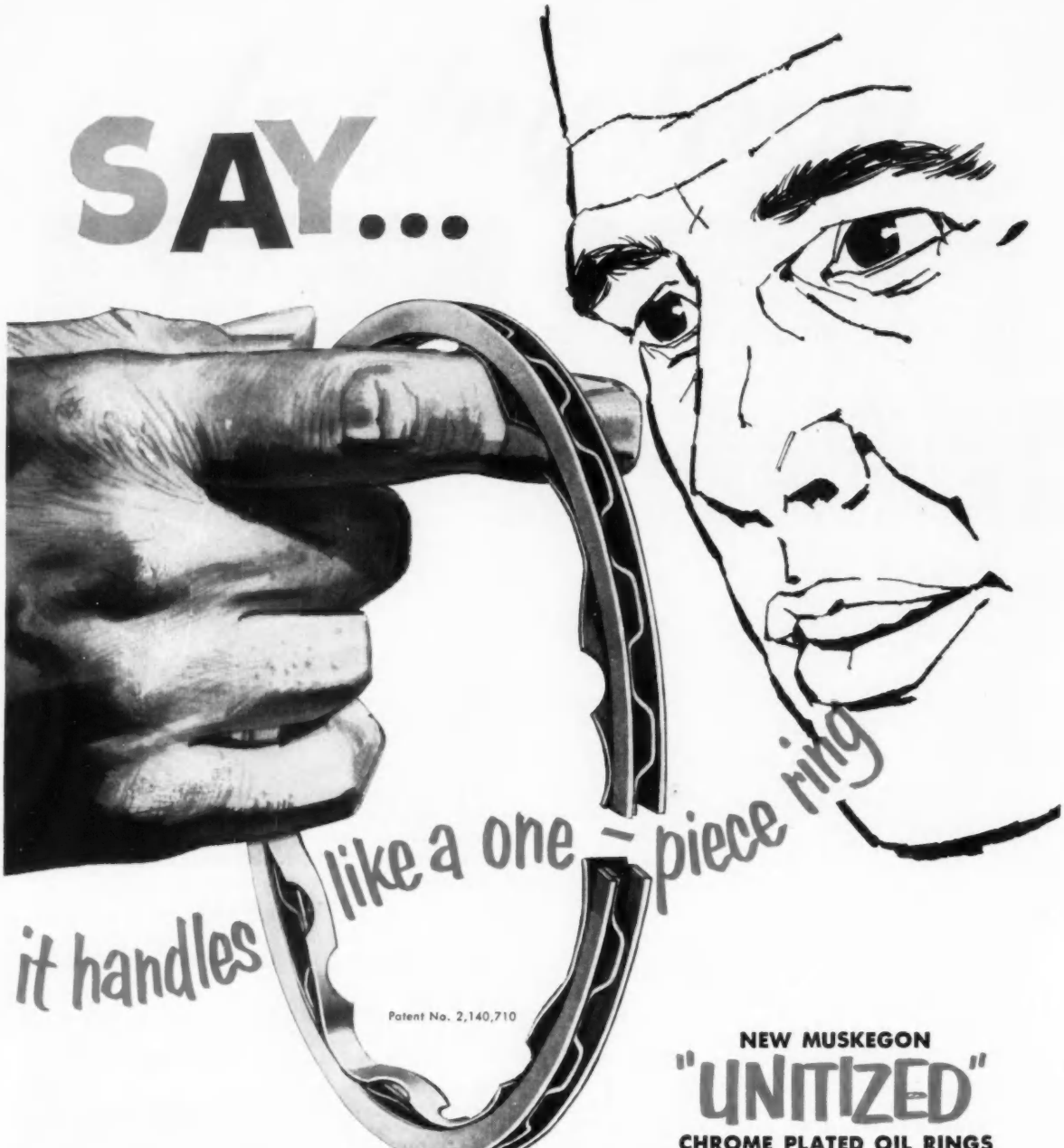
Most of us tend to form some sort of decision pattern; to fall into decision habits. Some decide pretty regularly that "There's nothing in it." Others, with equal regularity, decide the event or the fact can be used to *some* advantage.

Nor can anyone avoid decision-making . . . because failure to decide is in itself a tacit decision. In business or out, we never fool ourselves more than when we think we are avoiding the making of decisions.

Varied decisions in any group come oftener from differences in the deciders than in the events or the facts.

Each of us makes hundreds of small decisions every day. Few face more than one or two really big ones in a lifetime. So, most of our decision-patterns are shaped on the small items.

Whatever pattern our decision-making takes, it is very likely to chart the course of our lives.



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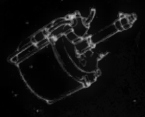

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*REG. U.S. PAT. OFF.

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That's why if you build, buy or sell passenger cars or trucks, it will pay to make sure they are equipped with Bendix power braking and steering.

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Radiation Rules Out Reactors for Small Planes and Autos

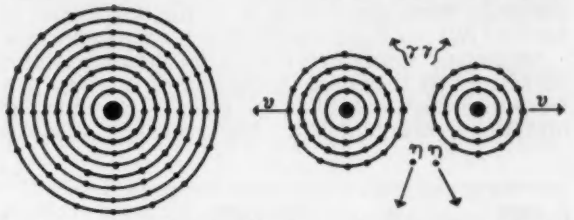


Fig. 1—One atom of uranium 235 splits to form two new atoms. The new atoms separate at high speed and collide with neighboring atoms, increasing their velocity and thereby raising their temperature. The heat energy can be extracted from the reactor and used . . . which is the principle of atomic—or nuclear—power. The splitting uranium atom also emits neutrons and gamma radiation. Both forms of radiation are dangerous to man

—at least until we develop light-weight shielding to bar neutrons and gamma-rays

Kenneth Kasschau, manager, Atomic Energy Department, American Locomotive Company

Based on paper "Atomic Power Vehicles" presented at SAE Metropolitan Section, New York, Sept. 16, 1954

THE current state of the art restricts mobile atomic powerplants to large-size vehicles. While work is under way on atomic-powered airplanes and submarines, the atomic-powered automobile is not yet in sight.

The reason is that while we know how to make both giant and small reactors, we don't know how to make compact, light-weight shielding. We have to use great masses of material to bar the dangerous neutron and gamma radiation that results when uranium fissions (Fig. 1).

The reactors shown on the next page are all big, relatively low temperature units—too big for mobile applications. But by using enriched uranium and

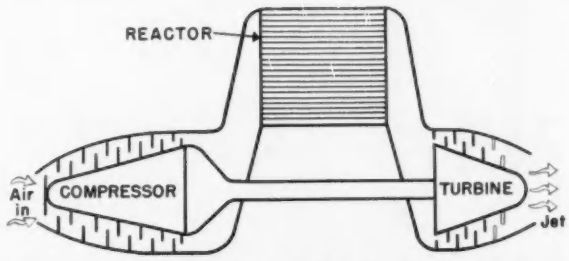


Fig. 2—In the direct-cycle atomic turbojet, air passes through the compressor of a more-or-less conventional turbojet. From there it goes to the reactor, where it picks up heat. Then it gives up some energy in the turbine that drives the compressor. The excess goes into the jet

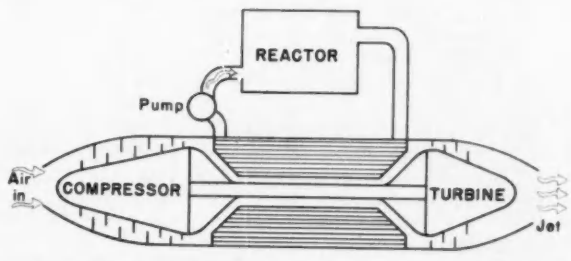


Fig. 3—In the indirect-cycle atomic turbojet, the compressed air picks up its heat energy in a radiator. This is a heat exchanger in which one phase is liquid solium or some other liquid used to cool the reactor. The coolant may heat the air directly or via an intermediate fluid

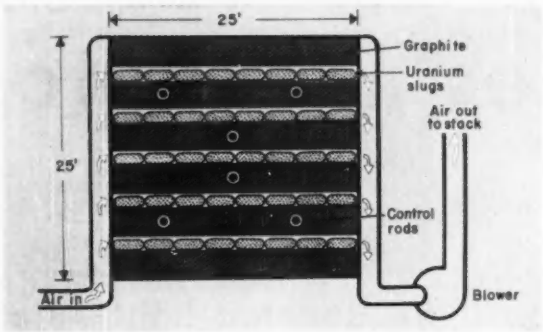
running the reactor at higher temperatures, we can compress powerplant bulk to within the limits of vehicles like our largest aircraft and our submarines.

"Enriched" uranium is simply uranium containing an artificially increased proportion of uranium 235. In nature the element occurs as 0.7% uranium 235 and 99.3% uranium 238. Unfortunately, it's the uranium 235 that fissions. Uranium can, however, be "enriched" to increase the proportion of the 235 isotope it contains. But the greater the enrichment, the more it costs.

Enriched uranium reactors can be made in small sizes with high power outputs. In fact, there is nothing in the reactor physics that prevents oper-

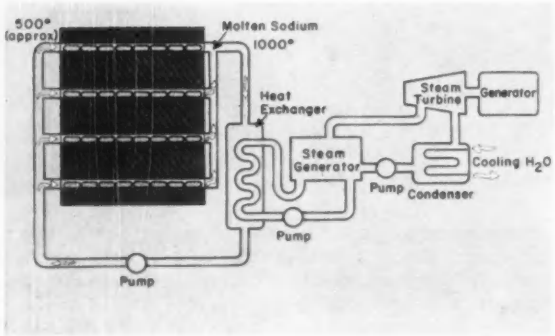
Typical Current Atomic Reactor

Graphite Natural Uranium Reactor



THE GRAPHITE NATURAL URANIUM REACTOR was the first pile built at Oak Ridge and the second pile ever constructed. Hundreds of pieces of graphite 4 to 8 in. square by 5 or 6 ft long form the large cube. Into each of the hundreds of cooling channels are inserted 40 or 50 uranium slugs about 1 in. in diameter and 4 to 6 in. long. All told, there are 30,000 or 40,000 slugs. A blower draws cooling air over the uranium and blows it up the exhaust stack. Control rods containing several percent boron control the reactor power by drawing neutrons away from uranium. Heat load is 3000–4000 kw, depending on ambient temperature of the cooling air.

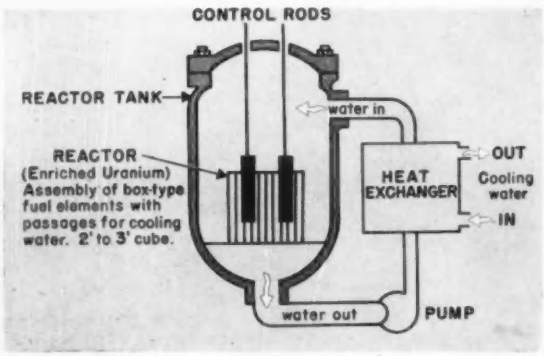
Sodium-Cooled Graphite-Moderated Reactor (S6R)



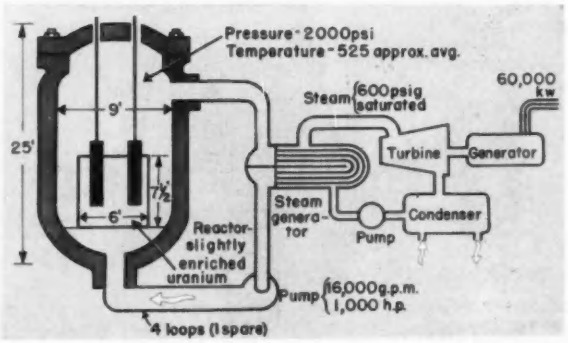
IN THE SODIUM–COOLED, GRAPHITE–MODERATED REACTOR, molten sodium at around 1000 F replaces the air that cools the Oak Ridge reactor. The hot sodium is pumped to a heat exchanger, where it gives up its heat through another sodium loop and an evaporator to water. The resulting steam runs a turbine that powers a generator. The double sodium loop insures that radioactivity from the reactor does not reach the steam system. North American Aviation is cooperating with the Atomic Energy Commission in developing this type of reactor system.

The General Electric SIR (submarine intermediate reactor) for the Navy's second atomic-powered submarine is a liquid-metal-cooled reactor but much smaller than the SGR. It produces superheated steam.

Materials Testing Reactor (MTR)



Pressurized Water Reactor (PWR)



ation at any desired power level. If you could get the heat out of the 15-in.-diameter tank in the solution-type reactor at North Carolina State College, you could run it at high power levels. It is heat removal that limits power output.

Figs. 2 and 3 show two ways the heat could be used to power an airplane. To produce 20,000 hp to propel the plane, the reactor must develop 100,000 hp worth of heat. Whether you use the direct or the indirect cycle, it's a big problem in heat transfer.

An even bigger problem is the shielding. About 2 or 3% of the power leaks out as neutron and gamma radiation. Thus on the 20,000-propulsion-hp, 100,000-heat-hp job, leakage will be 2000 or 3000 hp.

That's an enormous amount of radiation when you compare it with the 0.00000001 hp (one one-hundred millionth hp) exposure to which the health authorities now limit a person working a 40-hr week.

Of course, the farther you get from the reactor, the less radiation you will receive. If you were 15 or 20 feet away you would receive only about 1/1000 of the energy that leaks. But, with the 100,000-hp reactor, the radiation is still millions of times greater than you want to subject a pilot to.

Systems

THE MATERIALS TESTING REACTOR consists of fuel elements assembled into a cube. Cooling water flows through each fuel element. A big tank encloses the fuel assembly. The coolant circulates through a heat exchanger outside the tank. This reactor operates at a heat load of 30,000 kw.

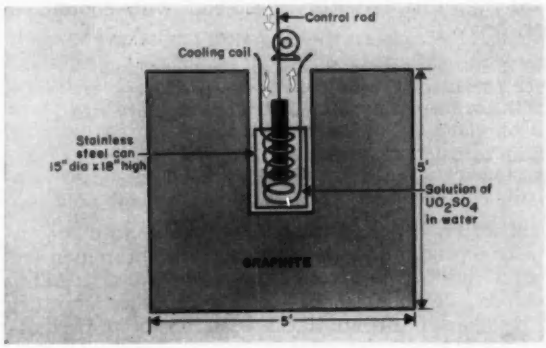
Westinghouse's STR (submarine thermal reactor) for the submarine Nautilus is a pressurized version of the MTR. It is a high-pressure, moderate-temperature, circulating-water system generating low-pressure saturated steam.

THE PRESSURIZED WATER REACTOR, an offspring of the MTR, is the one under development by Westinghouse and Duquesne Electric at Shippingsport, Pa. The reactor itself consists of a large bundle of fuel elements containing about 10 tons of slightly enriched uranium.

THE SOLUTION–TYPE (HOMOGENEOUS) REACTOR contains a "soup" of uranium salt dissolved in water. The graphic around the can bounces some of the escaping neutrons back into the can again. This allows the chain reaction to take place in a smaller vessel than it would without the graphic reflector.

North Carolina State College has built a reactor of this type, the first non-government-owned reactor in operation. It runs at 10 kw heat load.

Solution-Type (Homogeneous) Reactor



Shielding Is a Necessity

There must be shielding around any reactor. Luckily, the thickness of the shield necessary is proportional not directly to the strength of the source of radiation but only to the logarithm of the strength. To translate this to a specific example, consider a source which is 100 times too strong for a human to stand. Assume also that a 2-foot layer of some kind of shielding material cuts down the radiation to the point where the level outside the shield is safe for humans. If then we make the source 10 times as strong, we need increase the shield thickness only to 3 ft.

This follows from the fact that the log of 100 is 2 and the log of 1000 is 3. If a 2-ft layer was good enough for the 100-times-too-strong source, a 3-ft layer will take care of the 1000-times-too-strong source.

It's the weight and size of the shielding that precludes use of reactors in small vehicles. To see why that's so, let's take the example of a small personal airplane. Let's assume a reactor powerplant which delivers 75 hp for propulsion. And let's surround the reactor with a shield of alternate lead and water regions. The lead will stop the gamma rays but not the neutrons. The water will stop the neutrons although it doesn't inhibit the gamma rays. Together they'll catch both.

It'll Never Fly

Rough "back-of-the-envelope" calculations show that it would take 44,000 lb of shielding to protect the pilot. Since we have only 75 hp to fly the plane, it's obviously not flyable.

More calculations show that a 750-hp plane requires 54,000 lb of shielding. A 7500-hp plane requires 75,000 lb of shielding—still not flyable.

Let's try 75,000 hp. Who wants 75,000 hp, you say? Just ask the Air Force. That service would give its right wing for it right now.

Shield weight for the 75,000-hp powerplant is 125,000 lb. This is a lot of weight, but it's comparable to the fuel weight of our largest aircraft. Remembering that gross airplane weight runs about twice fuel weight in our large planes and assuming that shield weight replaces fuel weight, we have a 250,000-lb plane with 75,000 hp. (Weight of the atomic fuel would be negligible.)

Comparing these figures with the estimated fly-

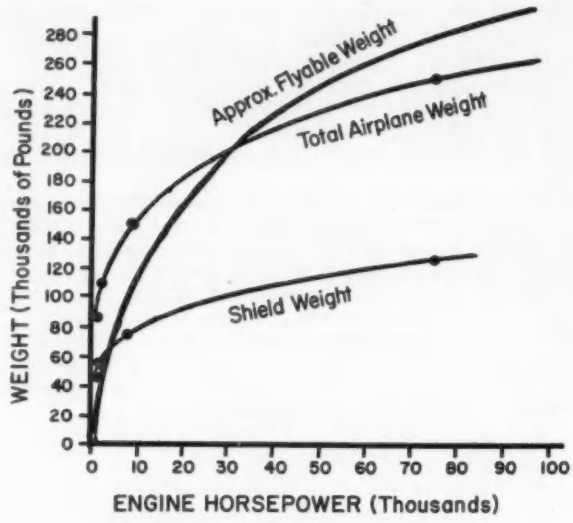


Fig. 4—Approximate flyable weight curve

able weight on Fig. 4 we see that the 75,000-hp plane should be able to fly.

Our calculations are very rough, but at least they are in the right ball park. Their chief value is that they demonstrate quite clearly that the current state of the art restricts mobile atomic powerplants to the larger-size vehicles.

Reactor-Powered Car at 50,000 Lb?

The passenger car with atomic powerplant is impractical because it takes as much shielding for 75 hp on the ground as it does for 75 hp in the air. And a 50,000-lb automobile isn't attractive.

The direct atomic powerplant does appear to have a place in military aircraft, submarines, and surface ships. Other applications in the transportation field must await developments in our knowledge of shielding.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

To Find Mistakes . . .

. . . is Inspection Department's main job; not to say how they should be corrected. That's production's job, quality control men think.

Based on a Production Forum Secretary's Report by **Richard H. Ede,** United States Steel Co.

BEST overall results accrue, many quality control men believe, when inspection's chief function is considered to be determining the quality of the product—not controlling the manufacturing operations under which it is produced.

Quality, it is reasoned, has to be accomplished by the production process itself, or by corrective operations if the process as it exists produces defects. So, since direct responsibility for operating conditions normally rests with the production department, it can be responsible for the degree to which the product conforms to accepted standards. . . . And statistical controls are among the best devices yet developed to help the production department control the quality of a product economically.

Quality problems can be analyzed most accurately, it would appear, if inspection is considered almost solely as the act of carefully examining, comparing the product with specifications, and communicating findings to those whose responsibility it is to take whatever action is indicated. This concept will bring out clearly the inescapable fact that quality is "built into the product."

Screening, sorting, detailing, or whatever it is called will prevent a portion of defective material from reaching the customer. But the only way quality can be improved is by improving the original process or by adding corrective operations after the defective material is caught. In general, these are both functions of the production department.

Where the chief inspector has the final "say so" as to whether the product is used, one may well ask: "Why should he not be held responsible for the outgoing quality of the product, even if he has no control over the processes under which it is produced?"

In answering this question, let us first face these facts:

a. If defective material is present in a product, only examination of each piece will screen out the bad material.

b. No inspector is 100% efficient. Many tests have proved that the man who will, day in and day out, remove 85 to 90% of the defective material he is looking for is the exception rather than the rule.

c. In this day of modern high production methods, the cost of anything bordering on 100% inspection is prohibitive.

Any manager who continues a process that is producing unsatisfactory material will, sooner or later, have to:

1. Hold his inspection department responsible for the quality of the outgoing product—with an inspection cost that tends to price his product out of the market, or
2. Ship so much unsatisfactory material to his customers to the extent that they will eventually buy elsewhere.

Inspection's prime responsibility should be to keep the production department and management informed as to the level of quality *while it is being produced.* Responsibility for producing satisfactory quality goes hand in hand with costs and quantities. All three are usually functions of the producing departments.

When it comes to analyzing quality at the time it is being produced, determining the causes of defective material, making recommendations for corrections, etc., the managements of hundreds of companies have come to believe that modern statistical methods are among the best tools available.

Nearly all manufacturers depend on others for a portion of the material used in their product. Here again, modern statistical methods of sampling incoming products are being offered by more and more large consumers as the best and most economical way to determine the quality of material as received.

These same people are learning that it pays to know what kind of quality control their vendors have.

(The full Secretary's report of which this article is an abridgment is available as SP-306 along with reports of the seven other Production Panels held at the 1954 SAE Production Meeting in Chicago on March 29, 1954. Price: $1.50 to members, $3.00 to nonmembers. Chairman of this Panel was F. J. Dalton, Deere & Co. Members were L. A. Knowler, State University of Iowa; A. C. Richmond, International Harvester Co.; Arthur Bender, Jr., Delco-Remy Division, GMC; and W. E. Jones, Management Controls.)

Modifying a Lodestar . . .

. . . transforms it into a high-speed, long-cruise, short-field, economical airplane, ideal for transporting corporate management with comfort exceeding that of commercial airliners.

Based on paper by **W. P. Lear,** Lear, Inc.

THE higher echelons of business executives are unlikely to be satisfied with less than the fastest air line speeds, which means 300 mph or better for their company planes. No airplane in existence fits the bill for this corporate management use. Modern two-engine air liners offer neither the speed nor the range desired, and to a lesser degree, they have the same drawbacks as the four-engined type. They require runway lengths too great to allow flexibility of destination. Their great cost pays for unnecessary size to carry an unwanted large number of passengers.

To raise the speed of its company-owned Lodestar, Lear has done a plastic surgery job to smooth out its warts, wrinkles and skin blemishes with surprising results. The experimental prototype is cruising close to 300 mph at altitude, with several speed modifications yet to be applied. Flying at normal cruise power between Chicago and Los Angeles it has stayed just 4-min ahead of a scheduled DC-6 all the way.

It was found practical to install additional fuel tanks in the outer wings, which together with the aerodynamic efficiency of the cleaned-up airplane, would provide an operating range of 3000 miles. Extensive research and experimentation led to marked reduction in cabin vibration and noise levels, including inaudible but fatiguing high-frequency sound. We developed an interior arrangement for seating 10 passengers, including two divans which expand into full length beds, a galley with hot and cold running water, a foldaway bar, folding tables, a spacious lavatory-dressing room with wardrobe, dressing tables, and in-flight luggage compartment.

When completed we will have an airplane, dubbed the Learstar, which can match the fastest airline schedules, give better than airline accommodations for up to 10 persons, afford transcontinental or transoceanic cruising range, excellent short-field performance, relatively low initial cost and extremely low comparative operating costs—the only airplane meeting all the requirements for corporate management transportation. (Paper "The Modern Executive Airplane as a Medium of Transportation" was presented at SAE Annual Meeting, Detroit, Jan. 15, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers).

Based on Discussion

Tom Salter, Cessna Aircraft Co.

I must disagree with the statement that the moguls of industry will never be satisfied with less than the fastest airplane speeds, since it apparently applies to speeds in miles per hour. Speed to the corporate traveler is to go where and when you need to go. Airline schedules must be based on potential fares available in one territory and as a result do not serve frequently, or at all, most places the corporation man wants to go—very likely will never do so. As an example, take Witchita to Omaha. The slowest airplane or helicopter conceivable can beat the airline, primarily because not too many people, except business people, go between the two cities.

The Learstar will fill a very definite need in industry, except that it may no longer be a short-field airplane.

Herb Rawdon, Beech Aircraft Corp.

A number of considerations are involved in the selection of an executive plane, not the least of which is the economics involved. The aircraft Mr. Lear has laid emphasis on is ideal for flights of long stages, but is not suitable for many applications requiring quick transportation on comparatively short flights with limited loads and to airports of limited capacities. The demand for the de luxe 300-mph airplane is going to be limited and it is extremely doubtful if the potential commercially used quantities can justify the engineering development and tooling expenses required for production.

NEW HEADLAMP features three design changes. As shown above, a filament shield has been added and the lens has been redesigned. Increasing the wattage of both upper and lower beams boosts light output

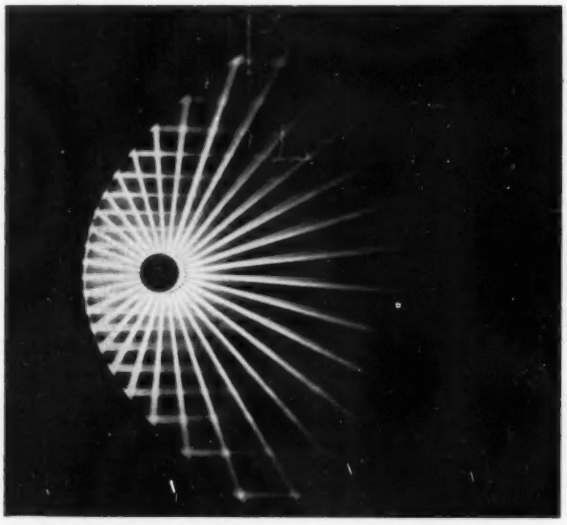
New Headlamp

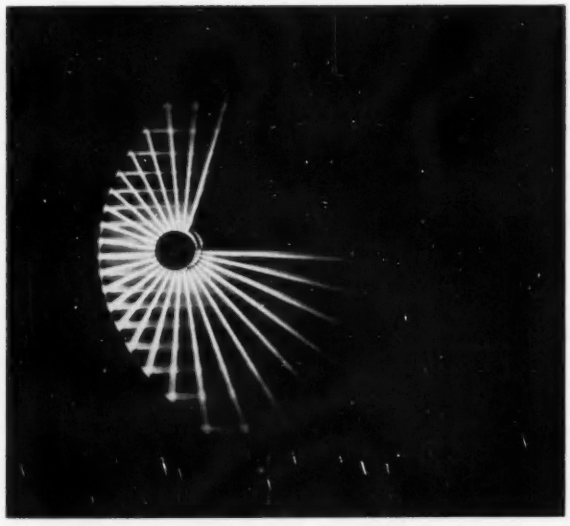
A NEW sealed beam headlamp—that increases night seeing distance with the lower beam and improves visibility in fog, rain, and snow—recently was announced jointly by the Automobile Manufacturers Association, the American Association for Motor Vehicle Administrators, and lamp manufacturers. In anticipation of the introduction of this new headlamp, SAE lighting standards were revised this past January.

New Lighting Gains

The new headlamp improves night driving in three ways:

1. It gives better light distribution on the roadway. Improved lower beam lighting adds as much as 80 ft seeing distance along the right side and shoulder of the road.





STRAY RAYS which don't reflect off the parabolic reflector, shine through the lens and restrict visibility in adverse weather. That's the situation with the current headlamp, shown at left. In the new headlamp, at right, the filament cap cuts off these undesirable rays, but not any of the main beam

Makes Debut

Betters lower beam seeing distance as well as bad weather visibility

2. By sharply reducing the stray light radiating upward from the lower beam filament, night seeing ability is noticeably increased in fog, rain or other bad weather conditions.
3. More light is provided throughout both beam patterns.

Several design changes in the headlamp make possible these gains. First, light output was increased by raising the lower beam wattage from 35 to 40 and the upper beam from 45 to 50 watts. The stray light above the horizontal has been cut down by placing an opaque shield or cap over the filament. It is located to prevent light from the bare filament from escaping upward, but doesn't interfere with the main beam formed by the reflector. Cutting down this stray light means that less light is reflected back to the driver's eyes from fog, dust, rain, and snow particles.

Changes in lens design also bend stray light rays below the horizontal downward and help improve light distribution. These headlamp changes and the results they produce are shown in the illustrations on these pages.

Lamp manufacturers already are tooling up for the new headlamp and expect to get into production as soon as possible. However, the new lamp probably won't be installed in new vehicles until mid 1955. That's because the statutes of some 22 states have to be modified to legalize the use of the new headlamps. It is expected that these state legislative bodies will take the necessary action early in 1955.

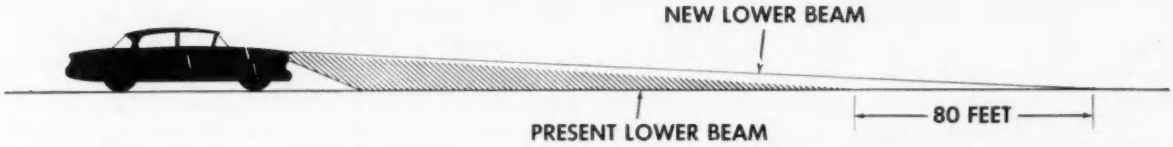
A Product of Technical Cooperation

The new headlamp was developed cooperatively by lamp manufacturers to meet driving requirements outlined by motor vehicle administrators. Vehicle and lighting engineers, working in SAE and AMA, cooperatively evolved the performance specifications for these headlamps.

Heading the AMA's Engineering Advisory Committee, under whose auspices the vehicle engineers participated, is C. A. Chayne, vice president of General Motors Corp. W. H. Graves, Packard Motor Car Co., is chairman of the Vehicle Lighting Committee under Chayne's group.

Among the SAE members serving on both the Vehicle Lighting Committee and the lamp manufacturers group are: P. J. Kent and J. B. Dickson, Chrysler; L. L. Beltz, Ford Motor; D. Perez, Electric Auto-Lite; G. E. Meese and V. J. Roper, General Electric; B. G. Booth, GMC; R. H. Bertsche, GMC Truck & Coach; R. N. Falge and H. C. Mead, Guide Lamp Division; T. E. Wagar, Studebaker; R. K. Braunsdorff, Tung-Sol Lamp; R. P. Kelly, Willys Motors; W. E. Carpenter, Westinghouse Electric; G. J. Gaudaen and W. F. Sherman, AMA; and Don Blanchard, SAE.

SAE members on the AAMVA Engineering Subcommittee who partipated in this program are: W. L. Cross, Jr., subcommittee chairman, Connecticut Department of Motor Vehicles, A. W. Devine, Massachusetts Registry of Motor Vehicles; and D. M. Finch, University of California.



INCREASED SEEING DISTANCE of as much as 80 ft along the right side of the road is provided by the lower beam of the new sealed beam headlamp

Experts Give Fork Trucks

THE fork truck is a tool for obtaining a maximum storage capacity with a minimum expenditure of manpower rather than a means of transportation. Generally speaking, its travel distance is limited to a maximum of 500 ft, but that distance will be modified by the speed and ramps involved in its operation.

Battery capacity sets a limit on the practical operating radius of an electric fork truck; but the real limitations are economic rather than physical. And this is true of the internal combustion powered vehicle as well.

The panel of materials handling experts who led the discussion on which this article is based consisted of:

Panel Leader:

L. C. Daniels, Vice-President, Material Handling, Buda Co., Division of Allis-Chalmers Mfg. Co.

Panel Secretary:

M. W. Hagen
Buda Co., Division of Allis-Chalmers Mfg. Co.

Panel Members:

J. Keresztury, Ass't Traffic Mgr., Operations, Bendix Products Division, Bendix Aviation Corp.

F. D. Lapham,
Electro-Motive Division, General Motors Corp.

F. C. Schuster, Chief Engineer, Buda Co., Division of Allis-Chalmers Mfg. Co.

L. F. Stanley, Engineer, Standard Oil Co. (Indiana)

B. I. Ulinski, Director, Engineering, Automatic Transportation Co.

A fork truck-trailer train has been used successfully for runs of 1100 to 1200 ft. Such an operation has merit when the load volume is low and available manpower and equipment do not permit loading and unloading of a tractor-trailer at the origin and destination of a run. The practical weight limit of the fork truck-trailer combination appears to be four to five trailers of 6000 lb capacity and a 7000 lb capacity fork truck. Combinations of this type have been operated on runs up to one mile. However, for long distance deliveries preference is given tractor-trailer trains running on a time and station schedule.

Choice of Power

Whether electricity, gasoline, diesel fuel or LPG is used to power a truck depends largely on how the truck is to be used. For inside use where food contamination is a problem, the electric truck is best suited. It lends itself to continuous use at low or moderate speeds with a minimum of ramp work. Normally, it is limited to 8 to 10% ramp grades. Where high speed, long haul, intermittent, or 6 to 24 hr operation is required, the gasoline, diesel or LPG powered vehicle is most suitable. Grade limit for gas and diesel is 20%.

Operating economy is the diesel's main advantage. It gives high efficiency with a cheaper fuel and in addition there is not the attendant crankcase dilution and sludging common to the gasoline engine at part throttle loads.

LPG eliminates about 75% of fumes, but the real reason for using it lies in reduced engine maintenance. Similar fume elimination can be achieved by using white (unleaded) gasoline sold by refineries as industrial gasoline. Because of the density of LPG vapor, there is constant fire hazard from spillage. Local laws govern its use and handling.

Higher compression ratios are needed to get all the power available in LPG. Experience also seems to indicate the need for stellite-faced valves and seats. An LPG installation costs about $300, and though it saves in engine overhauls it is doubtful if this saving alone would justify the installation.

A Going-Over

M. W. Hagen, Buda Co., Division of Allis-Chalmers Mfg. Co

Based on secretary's report of panel on Materials Handling, Plant Layout and Materials Flow, held as part of the SAE Chicago Production Forum, March 29, 1954

Special Equipment Can Cut Costs

Fluid drive will increase tire life by approximately 3 to 1. It will do even better for clutch life. Control is superior when inching a load into position and the elimination of starting jolts prevents damage to the load.

The solid tire is best where there is need for fast handling. Pneumatics are used mainly on rough terrain where additional flotation is desired. This feature is of special importance when a truck is used outdoors on asphalt in hot weather. Both solids and pneumatics have their troubles—pneumatics leak and solids lose chunks of rubber. In some applications, like stevedoring, large diameter solids are replacing pneumatics.

Radio Equipment Makes Trucks More Useful

Many operators report better use of equipment through radio dispatching. Part of the gain is no doubt due to the psychological effect on the operator. Two-way radio can be employed by simply installing a higher output generator on the truck. Installation is done by the manufacturer and costs approximately $500 for the dispatching equipment and $300 to $400 per truck unit. Weather and local conditions affect efficiency and FM has been found to suffer less atmospheric interference.

Change in position will eliminate most "dead spots" and these can be located with a portable set. A simple method for overcoming dead spots is to increase power.

Fork Truck Maintenance and Safety

Every unit of equipment should be readily identifiable and a continuous record kept of all maintenance required and scheduled. An engine hour meter provides a good basis for scheduling major overhauls. A daily driver check sheet should be used to signal the maintenance department of minor troubles. A qualified mechanic should do the greasing so that mechanical inspection can be done simultaneously.

The operator who has his "own" fork truck tends to take better care of it than if he gets his vehicle from a pool. If he feels his vehicle will be tied up, he hesitates to report minor accidents or needed repairs. Adequate standby equipment, therefore, tends to make preventive maintenance more effective.

Each operation has its own peculiar working conditions. Dust, silt, lint, and the like, are factors influencing operations. Only experience will tell what maintenance schedule is most economical.

Safety stems from a planned training program. Each department should have its own safety man. In one plant, a central safety committee composed of factory manager, safety man, and general foreman, talked about safety to two people every day for at least two minutes. In another plant, two foremen spend one week making departmental inspections in search of hazards. One company has two foremen, plant guard, and safety man make full plant inspection and then publish a written report.

There are other approaches, such as publishing full reports on accidents in the house organ, providing safety bulletins to show how safety equipment prevents accidents, using incentive prizes for safety records to make workers safety-minded.

(The report on which this article is based is available in full in multilithographed form together with reports of seven other panel sessions of the Chicago Production Forum. This publication, SP-306, is available from the SAE Special Publications Department. Price: $1:50 to members, $3.00 to nonmembers.)

Off The Road Tires:

TRACTION, flotation, rolling resistance, heat build up and durability of large off-the-road tires vary with the type of service the tire is designed for. Since earthmover tires must be used under various conditions, it's necessary to compromise the design. Here are some of the factors the designer must consider.

Traction

Good traction depends upon tread design and the tire's area of contact with the ground.

Fig. 1—Traction tread. The heavy, widely spaced lugs give good traction

Fig. 2—Rocktread. The heavy closely spaced lugs give good traction and protect the carcass

For maximum traction, the Traction design, shown in Fig. 1, is the most effective. It has heavy lugs, very widely spaced, and is self-cleaning. However, it doesn't protect the carcass or wear as well as the Rock design.

Fig. 2 shows the Rock design. It features heavy lugs, relatively closely spaced. Tires with this design have good traction and the heavy tread wears well.

Fig. 3 is the Overall pattern tire. It is often used on trailing wheels because it gives best carcass protection and tread wear under these conditions. But it has been used on traction wheels where extreme digging traction is not needed, such as on hard pavement.

On terrain with low shear resistance, like sand, traction depends more upon the amount of contact area and tire deflection than tread design. The larger the area of contact, the more friction is possible without scraping the surface and digging in.

For use on sand, the tire tread is generally thin, with well rounded shoulders and a non-aggressive tread pattern.

In mud that has some supporting qualities, a widely spaced traction type tire is very useful. Often mud is underlaid by hard dry ground. Then the big traction lugs penetrate through the mud and grip the hard surface below.

Flotation

Flotation is the ability of a tire to support its load on top of the ground and to roll over the surface rather than dig through it. The best flotation can be obtained with an extremely high deflection, large section, low pressure tire. This gives the tire a large ground contact area at low unit pressure. Like a camel's foot, it spreads over as much area as possible and compacts the soil beneath it for support.

Fig. 4 shows a comparison of the contact area of a wide base and conventional tire. The wide base tire has a rim to section ratio of 84%. The conventional tire ratio is approximately 68%. Thus, with nearly the same overall diameter and weight, the wide-based, earthmover tire has a greater cross sectional width and wider tread. As load is increased, the tire deflects and the contact area of the widebased tire increases faster than the conventional tire. This gives better flotation.

Fig. 5 shows how deflection obtains this increased

A Compromise in Design

C. W. Moss, Goodyear Tire and Rubber Co.

Based on Paper "Performance Characteristics of Large Off-The-Road Tires," presented at SAE National Tractor Meeting, Milwaukee, September 14, 1954

contact area. At low loads, the width of the contact area is actually greater on the conventional tire because of its flatter tread design. The length of the wide based tire contact area is greater than that of the conventional tire at all loads. As load increases, more of the wide based tire tread is brought into contact, thereby increasing contact area.

Although an earthmover tire rolls over ground, it rolls through mud. In mud, the contact area is obtained less by deflection than by penetration. That's because the mud cannot support the tire on top. For example, the projected area of the submerged portion of a 24.00-29 undeflected tire at a six inch depth is almost twice that of the flat surface contact area. However, it should be remembered that every inch of penetration increases rolling resistance 10 to 20 lb per 1000 lb of load.

Rolling Resistance

There are two factors in the soil itself which determines whether a tire will roll forward or not. One is the compacting ability of the earth; the other is its resistance to shear stress failure.

Dry sand has little compacting ability. With any more than very light unit pressure the sand slips from under the tire instead of compacting and supporting the load. The tire digs in instead of rolling over the ground.

One way of decreasing rolling resistance in loose material is reducing tire inflation. (On hard surfaces, decreasing inflation will have the opposite effect and increase rolling resistance).

Reducing inflation pressure will allow the tire to deflect and increase the ground contact area. Thus unit ground pressure decreases. Fig. 6 shows the results of a 24.00 tire at three different loads. The best inflation pressure for minimum rolling resistance is about 20 psi. Further reduction of pressure causes the tire to disturb the supporting column of sand and rolling resistance increases.

Rolling resistance of a large diameter tire is less

Fig. 3—Overall tread. The design gives good carcass protection but less traction

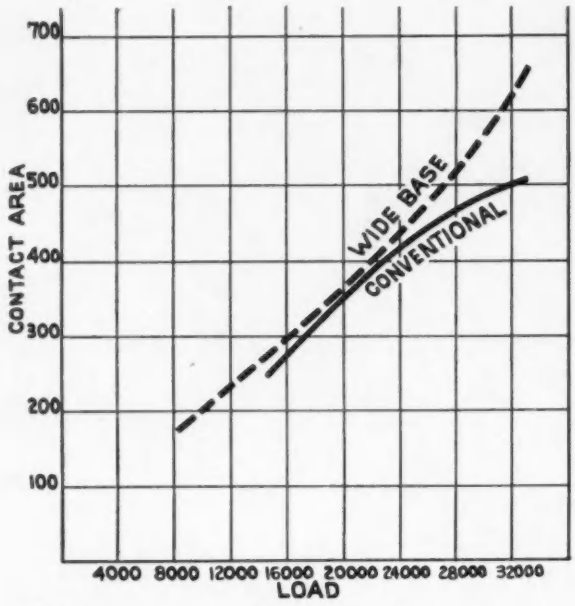


Fig. 4—This compares the contact area of a wide base and conventional tire under various loads. The more contact area the better the tire floats

than a smaller tire. Fig. 7 shows a comparison between an 18.00 and 24.00 tire, both at their rated loads. The rolling resistance in dry sand of the smaller tire is 95 lb per 1000 lb load at its best inflation. The 24.00 has only about 75 lb per 1000 lb load at its best inflation.

From this it can be seen that in loose material there is a best inflation pressure with its best contact area and unit ground pressure for every rated load. A case in point is the loaded earthmover which can cross soft terrain successfully, but after dumping its load it bogs down. This is because the tire does not deflect enough under its lightened load. It displaces the ground particles under its reduced contact area and sinks because it doesn't have a low enough inflation pressure for its reduced load.

Heat Build Up

Heat in a tire comes from road friction, the deforming of the tread rubber, and the flexing of the carcass while rolling on the road. The latter is by far the greatest source of heat.

The amount of heat build up in the carcass depends upon how much and often the tire deflects. Heavy loads or low inflation pressure will cause a large deflection. Road speed and the overall diameter of the tire determines how often the tire deflects. The greater the speed the more heat is generated.

Tread thickness and design also affect heat build

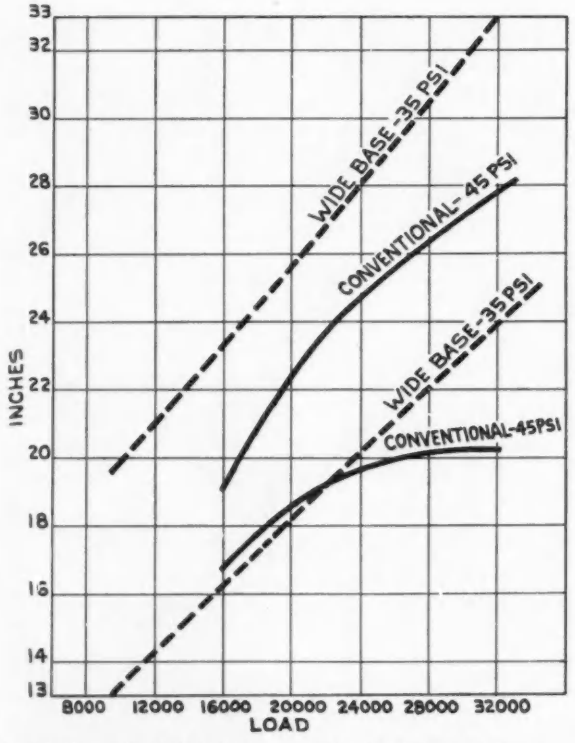


Fig. 5—Increasing load will increase the length of the contact area as shown by the upper two curves. Width increases as shown by the lower two curves

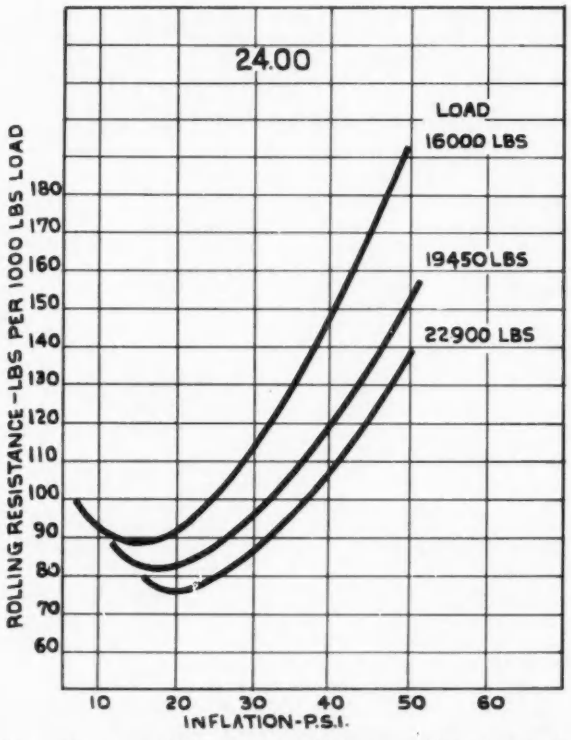


Fig. 6—Decreasing inflation pressure will decrease rolling resistance in dry sand to a certain point. Further pressure reduction will increase rolling resistance

up. A thick tread insulates and prevents heat from escaping the carcass. A widely spaced design is less insulating. However, on hard surfaces, a very widely spaced design concentrates road pressure directly on the carcass, and the tread lugs are easily bent. Since this builds up heat, the rock or overall type tire is better than the traction type for use on roads at high speed.

The large section tire does have one advantage in respect to heat. For any given cord tension, the intensity of shear in a tire becomes smaller as the tire size becomes larger. This means that when a large section tire and a small section tire are operating at the same relative deflection, the larger will have a lower maximum temperature and its temperature will rise at a slower rate.

Durability

Off the road tires must be built to withstand various tough conditions. Thick closely spaced lugs or bars protect the carcass against cuts, snags and bruises.

Naturally, overloading or under-inflating, or use under conditions not designed for, will shorten tire life. The Tire and Rim Association Load formula suggests loads and inflation pressures for earthmover tires. Higher deflection is allowed than on a corresponding road tire. This will not harm the tire unless it is operated on long road runs at sustained speeds.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Based on discussion

L. W. Fox
Firestone Tire and Rubber Co.

Recent exploration of wide-based tires has resulted in a tire height to section ratio lower than the approximate 94% for the conventional type tire. Leaving tire O.D. and section the same and increasing wheel diameter will save material and make a cheaper tire, but would add nothing to performance. Keeping tire O.D. the same and putting a wider tire on a wider rim will help performance and will probably improve tire life with little increased cost.

Since contractors habitually overload tires, the future will see more plies and higher inflation in wide base tires to carry these loads. Ultimately this may show a lower cost per 1000 lb of tire rating.

Bruce O. York
United States Rubber Co.

Different manufacturers have different tread designs and carcass constructions. This indicates that all do not draw the same conclusions regarding the effects of these factors on performance requirements.

Tire flexibility is a "must"; not only to produce the necessary deflection but also to entrap loose particles of sand beneath the crown center of the tire. Thus, the density of the particles is increased and the lateral displacement is restricted.

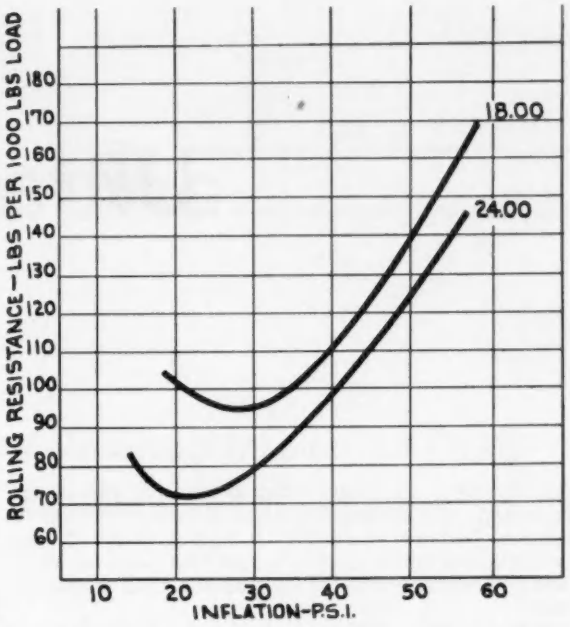


Fig. 7—Rolling resistance of a large diameter tire is less than that of a smaller tire. Both 18.00 and 24.00 tires are at rated loads for 10 mph speed in dry sand

Tread design has a very real effect on the flexibility of the tire in the crown area where the soil is trapped. Radial or diagonal lugs have a trenching effect, tending to bury the tire. Circumferential ribs and grooves minimize the directional displacement of the sand particles.

Heat will affect the strength, adhesive and cohesive qualities of the tire material. High temperatures may weaken and separate the layers of rubber stocks from the tire cords or bead wires. Also tire cord strength is reduced.

Machine designers should design enough space to permit the use of large tires. Then loads can be carried at the best inflation pressures, resulting in more driver comfort and less machine damage.

R. V. Snyder
B. F. Goodrich Co.

Earthmover tires are allowed more deflection because there is a definite speed limitation on each Off-The-Road loadtable.

On hard surfaces, where there is little penetration, tire inflation should be kept at the maximum recommended for the load carried. This will reduce rolling resistance and thereby result in cooler tire operation.

The cord stress factor limits the maximum inflation of a tire depending upon the ply rating in a certain limited speed operation. Other things being equal, the wider the section, the lower the recommended inflation must be to retain the same cord stress.

Ultrasonics Inspect

REMEMBER way back when a piece of metal was tested by hitting it with a hammer? If it *clanked* instead of *clinked* it had a flaw. Today, sound is still being used to inspect for defects. Only now you can't hear it. It's ultrasonic high frequency sound.

Ultrasonic inspection is being used successfully in mass production industries to detect flaws in a wide variety of fabricated parts. This non-destructive method, using high frequency sound waves, can find defects on the surface and within the material, and may be used to measure material thickness, too.

There are three methods of ultrasonic testing in common commercial use today: (1) pulse echo, (2) resonance, and (3) transmission. A fourth system, using frequency modulation is a recent newcomer to the field.

1. The Pulse Echo Method

Perhaps the simplest and most versatile of the three methods is the pulse echo method. It locates defects by means of the echo principle. This is how it works:

A pulse of ultrasonic vibrations is sent through the part to be tested with the aid of a quartz crystal transducer. A picture of a transducer unit is shown in Fig. 1. (The crystal is piezoelectric and it changes dimensions when a voltage is applied across the face. If this is a high frequency alternating voltage, the dimensions change rapidly and ultrasonic vibrations result.)

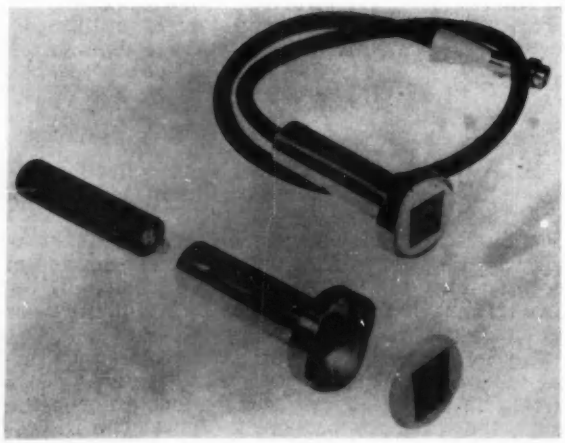


Fig. 1—This is a typical crystal transducer used in ultrasonic inspection. It interchanges electrical and mechanical energy

The vibrations are carried from the crystal to the material by a thin layer of oil. Fig. 2 shows how the ultrasonic compression wave travels through the material until it hits a flaw. Part of the wave is bounced back by the defect, the rest continues. That's because ultrasonic waves are transmitted easily through solids, but they are nearly 100% reflected at an air boundary. Since flaws are really gas, or slag filled cavities, they reflect the ultrasonic waves.

The reflection is picked up by the crystal transducer, which now acts as a receiver, and is impressed on an oscilloscope as a pip. Then, after a further interval of time, the reflection from the back face of the part returns and shows up on the scope. The difference in time between the two pips, translated into distance, locates the defect. An actual photograph of the oscilloscope screen is shown in Fig. 3.

The pulse echo method has certain advantages over other methods of inspection. These advantages can best be pointed up by describing the system in use.

First of all, the pulse echo system is portable. A testing unit may be taken to any part of the plant, or into field. By periodically inspecting highly stressed machinery as shown in Fig. 4, safety is increased and down time, caused by equipment failure, is reduced.

The pulse echo system can detect sub-surface de-

On Production Line

Results:

- ✶ Better Quality Control
- ✶ Reduced Inspection Costs
- ✶ Faster Production Rates
- ✶ Safer Plant Equipment

Edward F. Weller, Jr., Research Laboratories Div, General Motors Corp

Based on paper "ABC's of Ultrasonic Inspection" presented at SAE Summer Meeting, Atlantic City, N. J., June 9, 1954.

Discussion by W. I. Bendz, Chief Engineer, Sperry Products, Inc., is in this italic type.

fects which the magnetic particle and liquid penetration inspection methods are incapable of finding. Jet engine compressor rotors, highly stressed ring bosses on castings, and long rods up to 30 ft in length are some of the widely varied equipment on which pulse echo testing proved successful.

Flaws in forgings can be detected even if they have been forged flat. Stainless steel turbine forgings were some of the first production parts to be inspected with this system. Since turbine wheels spin at high speeds and are highly stressed, it is important that all flaws be detected.

By slightly modifying the test equipment, it is possible to generate surface waves instead of penetrating waves. This enables the pulse echo method to find scratches and defects on or just below the surface of a solid. Flaws have been found on flat

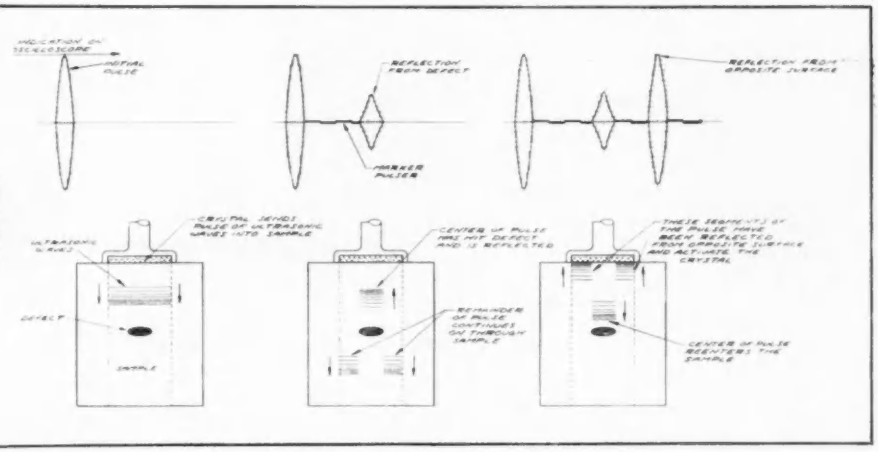

INDICATION ON OSCILLOSCOPE
METAL PULSE
REFLECTION FROM DEFECT
MARKER PULSES
REFLECTION FROM OPPOSITE SURFACE
CRYSTAL SENDS PULSE OF ULTRASONIC WAVES INTO SAMPLE
ULTRASONIC WAVES
DEFECT
SAMPLE
CENTER OF PULSE HAS HIT DEFECT AND IS REFLECTED
REMAINDER OF PULSE CONTINUES ON THROUGH SAMPLE
THESE SEGMENTS OF THE PULSE HAVE BEEN REFLECTED FROM OPPOSITE SURFACE AND ACTUATE THE CRYSTAL
CENTER OF PULSE REENTERS THE SAMPLE

Fig. 2—The ultrasonic pulse travels through the material until it is bounced back by a defect. Flaw shows up as pip on an oscilloscope

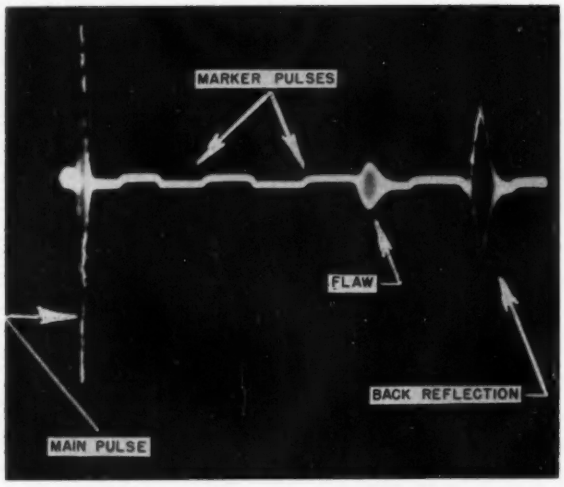


Fig. 3—This photograph of a pulse echo system cathode ray screen shows the difference between a flaw pip and a back reflection pip. Marker pulses are calibrated to represent distance, thereby locating the flaw

or curved surfaces of such metals as steel, aluminum, beryllium, magnesium and titanium.

Another advantage is its ability to detect small intersurface or bond defects while X-ray tests will only detect volume voids. Fig. 5 shows the pulse echo system being used to examine the weld in a fabricated traction motor frame. Using a 45-deg angle transducer crystal, the ultrasonic wave was sent into the material at an angle and directly into the weld.

For other cases different angles are used. As illustrated in Fig. 6, crystal angles of 24, 19, and 15.5 deg. are used to detect angle cracks in areas which otherwise would be impossible to test.

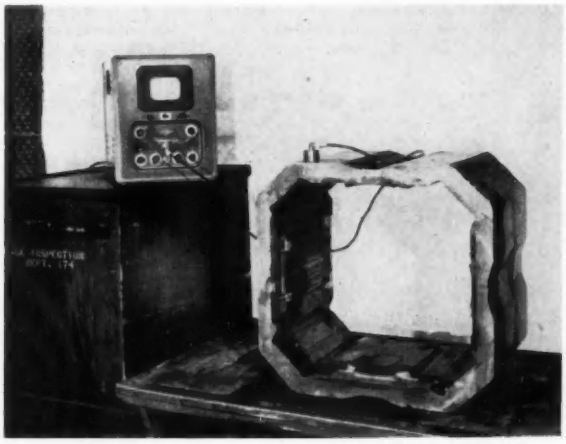


Fig. 5—Using a 45-deg angle transducer crystal it is possible to examine the weld of this traction motor frame

Fig. 4—The crank of a large press is being examined for flaws with a pulse echo testing unit. Periodic inspection of highly stressed parts improves plant safety and reduces down time caused by equipment failure

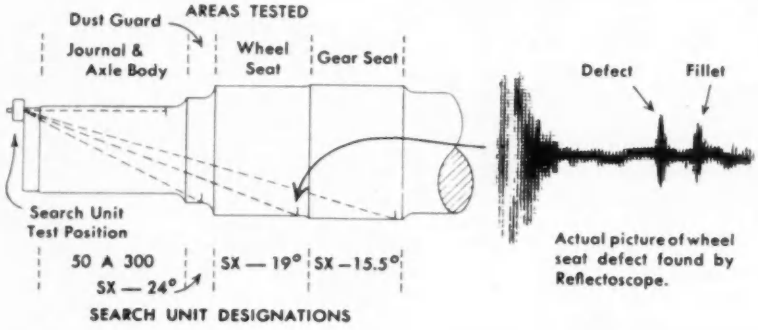


Fig. 6—Inaccessible areas can be tested by using specially designed transducer crystals. Here search unit angles of 24, 19, and 15.5 deg. are used to detect wheel seat cracks in an axle

2. The Resonant Method

The resonant system uses resonant vibration to measure thickness and locate defects. It differs from the pulse echo system both in principle and use.

Instead of applying a pulse of energy to the transducer, as in the pulse echo system, the quartz crystal of a resonant unit is set into vibration by a continuous high-frequency voltage. This vibration is passed into the material as shown in Fig. 7. When the frequency applied by the crystal is the same as the resonant frequency of the material, the piece will begin to vibrate, reinforcing the original ultrasonic waves. This will cause an increase in current which, measured by a meter, indicates when resonant frequency is reached. Since the velocity of sound in the material is known, the thickness can be computed from the frequency.

A modified version of this instrument uses a calibrated cathode ray tube to measure thickness directly. (See Fig. 8.)

The resonant method is designed primarily for testing thin sections from about 0.015 inch to 0.400 inch. However, thicker material can be inspected by employing harmonics. Figs. 9, 10, and 11 illustrate how harmonics can determine thickness in a block being tested with the resonant method.

The resonant system has been successfully used in production line inspection of jet engine diffuser rings. It was possible to measure the thickness of the casting walls within 0.005 inch.

Another use is testing rubber to steel bondings. Fig. 12 shows a section of a bond containing a void which was detected by this method. Since the ultrasonic energy is greatly absorbed by rubber, there is no resonance in the piece where the rubber to steel bond is good. Where there is a void, the

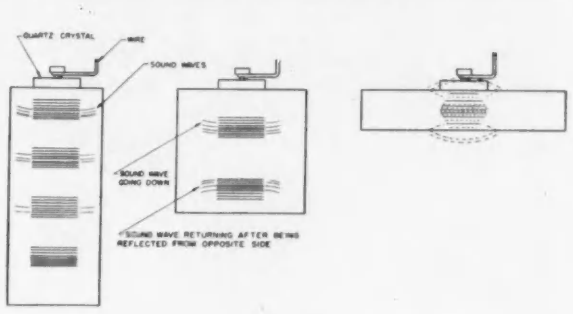


Fig. 7—In the resonant method, the transducer is vibrated at a high frequency. When this frequency is the same as the material's resonant frequency the piece will begin to vibrate as shown in the third drawing. Thickness can be computed from the frequency

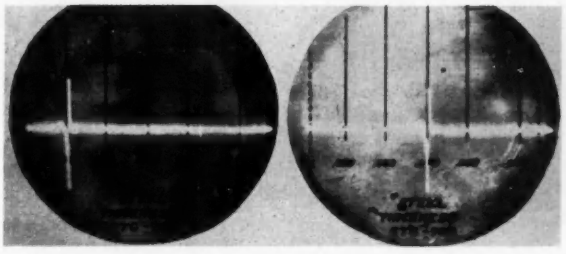


Fig. 8—These cathode ray tubes are calibrated to show thickness directly. The one on the left indicates a steel thickness of 0.05 in.; the one of the right, 0.07 in.

How The Resonant Method Determines Thickness

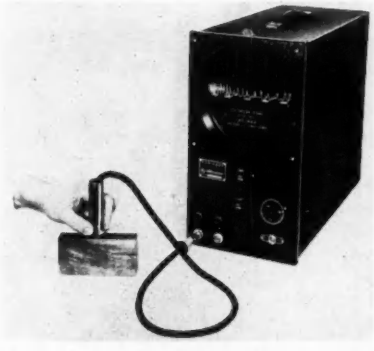


Fig. 9—The crystal transducer is over a flawless section of a test block and the harmonic pips on the scope correspond to the total thickness

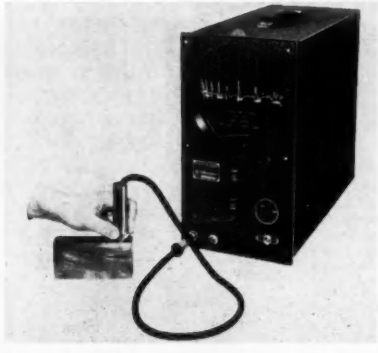


Fig. 10—If the crystal is placed over the parallel saw cut then the thickness reading indicates the depth of the flaw

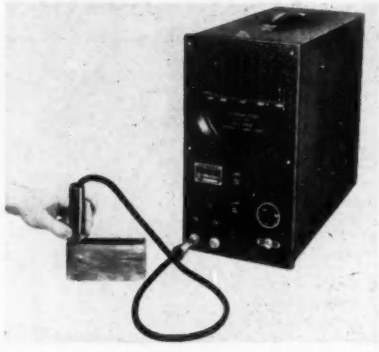


Fig. 11—If the saw cut is not parallel, then no thickness indications appear on the screen because the material will not vibrate in resonance

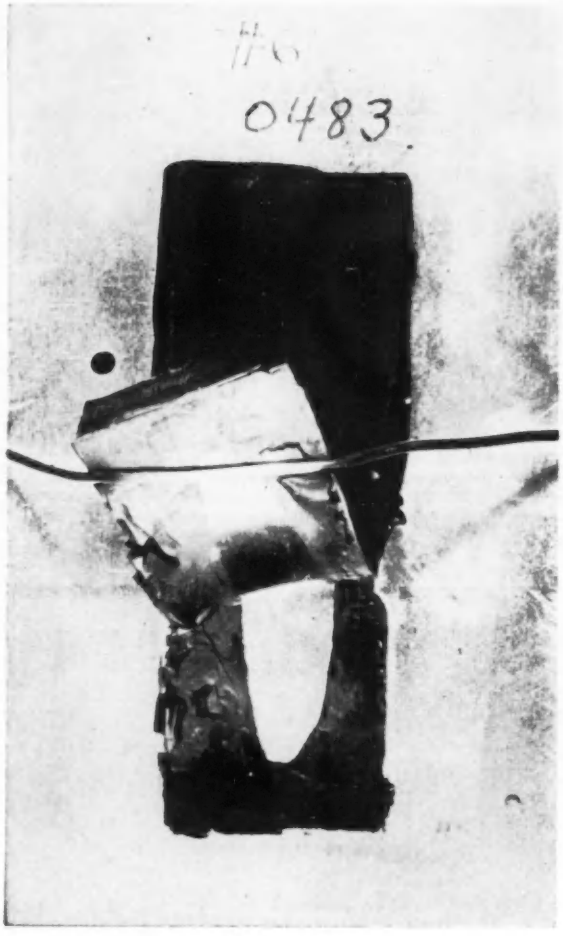


Fig. 12—This void in a rubber to steel bonding was detected by the resonant ultrasonic testing method.

Fig. 13—This is a specially designed transducer crystal and holder for examining cylinder wall thickness

metal vibrates and the thickness of the steel alone will be indicated.

Although most resonant system instruments are only semi-portable, special units have been designed for particular jobs. A small portable unit has been devised for inspecting the bolt hole area of railroad tracks. It is strapped to a person's back and it indicates flaws by an audible signal.

Fig. 13 shows another specially designed unit: for measuring cylinder walls. A special crystal and holder were made so that the entire surface of the cylinder wall could be scanned.

The above are just a few of the many uses for resonant testing equipment. However, this system requires that both surfaces of the piece to be tested are relatively smooth and nearly parallel. Exceptionally porous castings, material with large grain size, and uneven surfaces limit the use of this system.

3. Transmission Method

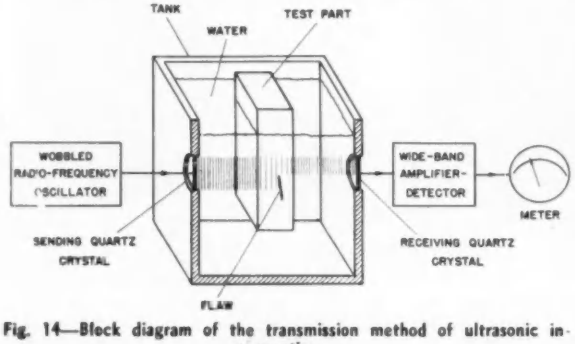


Fig. 14—Block diagram of the transmission method of ultrasonic inspection

The ultrasonic transmission inspection method provides a speedy quality test for small parts. This is how it works.

Compression waves are sent by a transducer through a test piece and are picked up and measured on the other side. Usually the piece is submerged in a liquid. A diagram of an ultrasonic transmission system is shown in Fig. 14. It consists of sending and receiving crystals, a test tank and liquid, a high frequency oscillator, and detector. The energy detected by the receiving crystal indicates the quality of the piece under test.

Bolts, brazed bonds, valves, and laminated stock are typical pieces which have been tested by the transmission method.

One manufacturer was faced with the problem of inspecting a large quantity of bolts as quickly as

possible. By using the transmission method he was able to check 1000 bolts in 1¼ hr as compared to 1000 bolts in 10 hr by another method . . . eight times faster! Some examples of bolts sorted by the transmission method are shown in Fig. 15. Both cup flaws and narrow filamentary flaws were detected.

Submerging a test piece in a liquid is more advantageous in some cases than pressing the transducer against its surface. Since it is not necessary for the crystal to touch the test piece, the surface finish requirements are not as great as in the other methods. Too, testing is more uniform for all pieces.

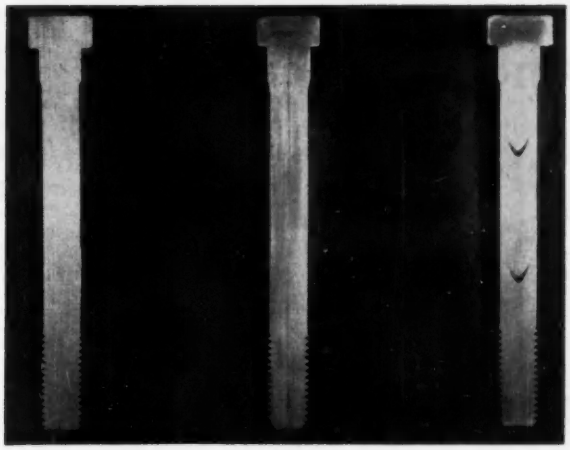


Fig. 15—The transmission method sorted out these bolts during an actual production line inspection. Sound bolt is on the left. Middle bolt has filamentary flaw. Right bolt shows cup flaws

4. Frequency Modulation Method

The frequency modulation method is a recent newcomer to the ultrasonic inspection field. It operates similarly to an aircraft altimeter.

Usually combined with the submersion method, it is used to inspect parts with complicated shapes. (It is also possible to combine submersion with the pulse echo method for similar odd-shaped problems.)

None of the above methods will solve all problems. Often special test fixtures and special transducers must be built for a particular job. Each instance must be studied to find out which method will effect the best results.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Automatic Test Equipment

Instruments for automatically scanning jet rotors and permanently recording the results are now in use at the Allison Division of General Motors, reports discusser Bendz. The following illustrates the Allison installation.

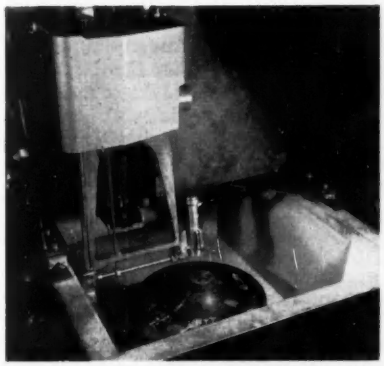


Fig. 16—The rotor is scanned ultrasonically in an immersion tank on a rotating turntable

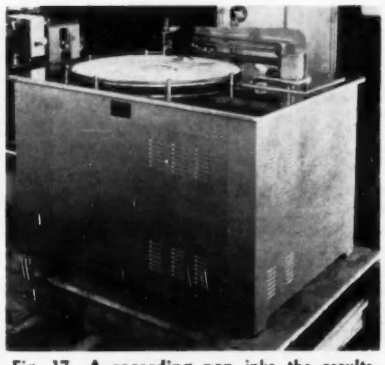


Fig. 17—A recording pen inks the results on a chart which is revolving in sync with the turntable

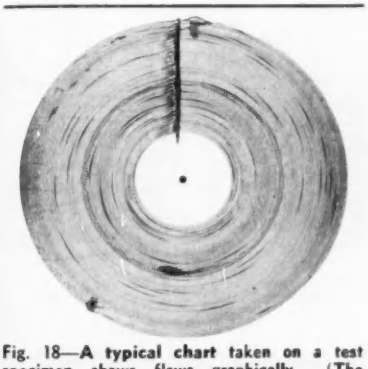


Fig. 18—A typical chart taken on a test specimen shows flaws graphically. (The overlapping vertical marks at the top indicate the machine is operating correctly)

Chemists think:

Chain Reactions of

CHEMICAL research during the past few years has contributed much to our understanding of engine knock and its prevention. For instance, we believe that knock is caused by very fast, precombustion reactions of species containing hydrogen and oxygen. The formation of these species depends upon the compression ratio, temperature, and molecular structure of the fuel. And, species of lead oxide or metallic lead will slow down the reaction and reduce knock.

Knock is an Old Problem

We have known for a long time that knock happens when the "end gas" burns so rapidly that a shock wave is set up. Any conditions which raise the temperature or pressure of the fuel-air mixture (such as increased compression ratio or intake air temperature) will promote knock. Tied closely to knock are the cool and blue flames which appear just before detonation. The reasons for this seem to be hidden in chemical reactions which take place in the fuel preceding knock.

We know that these chemical reactions take place because:

(1) Measurements indicate as much as 25 to 40% of the total combustion energy is released *before* a hot flame appears.

(2) Cylinder pressure rises abnormally high before knock. This is due to the heating and expanding of the charge. Also, the number of molecules in the system is increased because of the degradation of the fuel by oxidation.

(3) Qualitative analysis of "end gas" has found that the fuel has been oxidized into other products prior to autoignition.

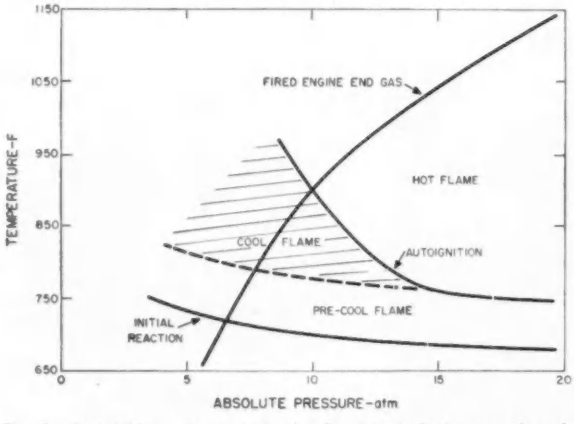


Fig. 1—A stoichiometric mixture of n-heptane and air goes through pre-cool flame, cool flame, and hot flame regions as compression ratio is increased. The initial oxidation reaction starts about 50 to 75 deg F below the formation of cool flame

Precombustion Reactions Cause a Cool Flame

The complete burning of a hydrocarbon fuel is a very complex process. The overall equation for the oxidation of heptane is

$$\underset{\text{(heptane)(oxygen)}}{C_7H_{16} + 11O_2} \longrightarrow \underset{\text{(carbon dioxide)(water)}}{7CO_2 + 8H_2O}$$

This does not occur in one step, but by a series of collisions of oxygen molecules with the heptane molecules to form, first, a series of intermediate products. Finally, the reaction ends with carbon dioxide and water.

The first product formed by the reaction of a hydrocarbon with oxygen is peroxide.

$$\underset{\text{(hydrocarbon)(oxygen)}}{C_7H_{16} + O_2} \longrightarrow \underset{\text{(peroxide)}}{C_7H_{15}OOH}$$

Peroxide is very unstable at the high temperatures of the end gas. It decomposes in two different ways:

(1) **Fission of the molecules,** which yields two radicals.

$$\underset{\text{(peroxide)}}{ROOH} \longrightarrow \underset{\text{(radicals)}}{RO^\circ + OH^\circ}$$

H-O Radicals May Be Knock Cause

B. M. Sturgis, E. I. du Pont de Nemours & Company, Inc.

Based on paper "Some Concepts of Knock and Antiknock Action," presented at SAE National West Coast Meeting, Los Angeles, Aug. 18, 1954.

Each radical promotes further oxidation of the hydrocarbon.

RO° or OH° + Hydrocarbon ⟶ Rapid oxidation

(2) **Thermal decomposition,** which forms the relatively inactive aldehydes, ketones and olefins.

$$\underset{\text{(peroxide)}}{ROOH} + \text{heat} \longrightarrow \underset{\text{(aldehydes)}}{R\text{-}\overset{\overset{O}{\|}}{C}\text{-}H} + \underset{\text{(ketones)}}{R\text{-}\overset{\overset{O}{\|}}{C}\text{-}R} + \underset{\text{(olefins)}}{R\text{-}CH=CH\text{-}R}$$

Fig. 1 shows the typical precombustion reactions for a stoichiometric mixture of n-heptane and air. At low compression ratios there are no precombustion reactions. As compression ratios are increased, peroxides are formed. This usually happens about 50 to 75 deg F below the temperature required for a cool flame. Further increases in compression ratios give rapidly increasing amounts of peroxides. These peroxides decompose by fission to form oxygen-hydrogen radicals.

Some of these active radicals recombine, forming hydrogen peroxide. Also, thermal decomposition increases the amount of aldehydes, ketones, and olefins. A cool flame appears at this point as a result of the further oxidation of these decomposition products.

Before the cool flame, the fission reaction dominates. But after, the thermal reaction appears to dominate. This causes the whole oxidation process to level off during the cool flame period as shown in Fig. 2.

Thus, hydrocarbon oxidation preceding combustion appears to form organic peroxides. These decompose and inter-react to form hydrogen peroxide, formaldehyde and radicals having high amounts of energy.

Blue Flames Occur Just Before Knock

Most hydrocarbons also give rise to a blue flame just prior to autoignition, particularly if the mix-

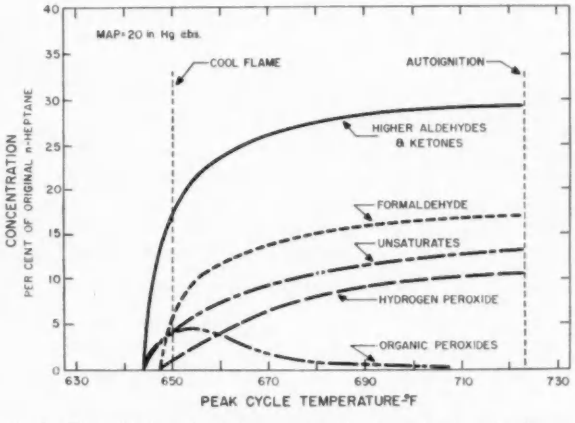


Fig. 2—The oxidation of a hydrocarbon (n-heptane) involves the formation of organic peroxides aldehydes and ketones. These decompose and interact to form hydrogen peroxide, formaldehyde, and oxygen-hydrogen radicals having high amounts of energy

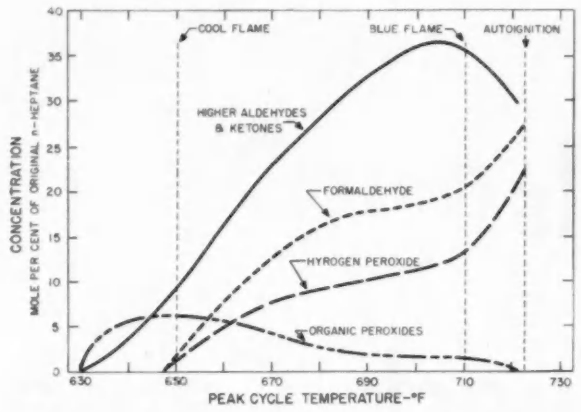


Fig. 3—Near the end of the cool flame period, the radicals chain-react producing an ever-increasing number of radicals. These react rapidly to cause autoignition

ture is lean. This is not just a more intense cool flame, but appears to be a somewhat different phenomenon. Fig. 3 shows that near the end of the cool flame period the radicals *chain-react* to produce an ever-increasing number of reactive radicals. This is accompanied by a blue flame.

A large number of simple radicals such as OH′ or HO_2' are formed, some of which combine to form hydrogen peroxide. Others react with increasing rapidity to cause autoignition and knock.

Knock is Caused by Oxygen-Hydrogen Radicals

Previous experiments showed that the combustion of hydrogen in an engine produced knock. Also, the addition of tetraethyl lead to the hydrogen fuel reduced knock. These and other similarities suggested that the same types of chemical reactions caused knock in both hydrogen and hydrocarbon fuels. Since with hydrogen these reactions can only be between simple substances containing hydrogen and oxygen, then hydrocarbon knock is probably the result of reactions of these same substances.

This theory was supported by experiments which showed that combustion of a fuel that contained no hydrogen, such as carbon monoxide, knocked very little. As moisture was removed from the carbon monoxide-air mixture, the tendency to knock became less. Therefore, we may assume knock is related to the presence of simple hydrogen and oxygen radicals.

Fuel Molecular Structure Determines Oxidation

Although the knock reaction may be a simple one, the formation of the critical concentrations of the hydrogen and oxygen species necessary to trigger the reaction depends upon the molecular structure of the fuel.

N-heptane, as we have seen, started to form oxidation products at the relatively low temperature of 645 deg F. It quickly gave rise to a cool flame, and produced large amounts of reaction products prior to autoignition at 723 deg F.

Isooctane oxidizes more slowly than n-heptane and produces a smaller quantity of preflame reaction products. This is shown in Fig. 4. This is because oxygen has difficulty attacking isooctane, and the peroxides which are formed have greater stability. Only about 7% of the isooctane is changed to other substances prior to autoignition. Some organic peroxides exist right up to autoignition. The formation of the critical concentration of species responsible for knock takes place slowly and is not accomplished until 975 deg F is reached.

Diisobutylene oxidation occurs in the same temperature region as isooctane. But the reactions are inhibited as shown in Fig. 5. The organic peroxides apparently do not decompose into substances that give rise to cool flames.

Hydrocarbon blends generally give good antiknocking characteristics, by slowing down the oxidation processes. Olefins inhibit their own oxidation and act to inhibit the oxidation of paraffins.

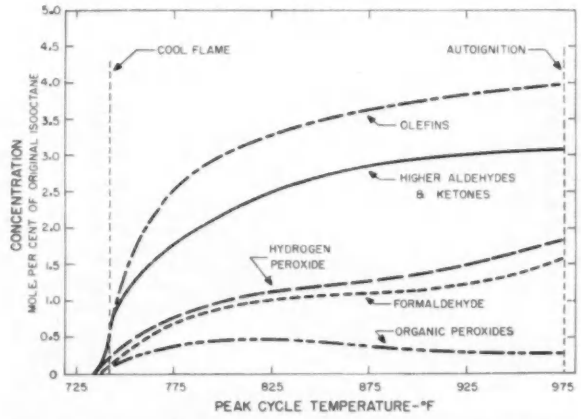


Fig. 4—Isooctane oxidizes more slowly than n-heptane and only about 7% is changed to other products before autoignition. The crictical concentration of species responsible for knock isn't completed until 975 deg F

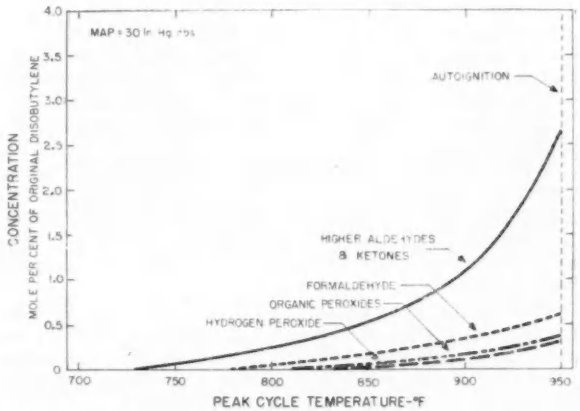


Fig. 5—In diisobutylene the organic peroxides do not undergo the type of decomposition necessary to give rise to cool flames

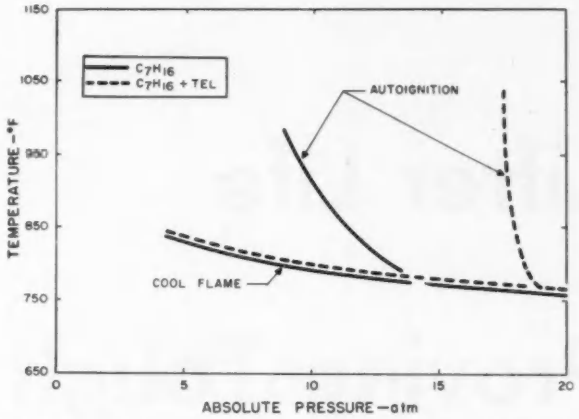


Fig. 6—TEL displaces the autoignition limits to regions of higher temperatures and pressures

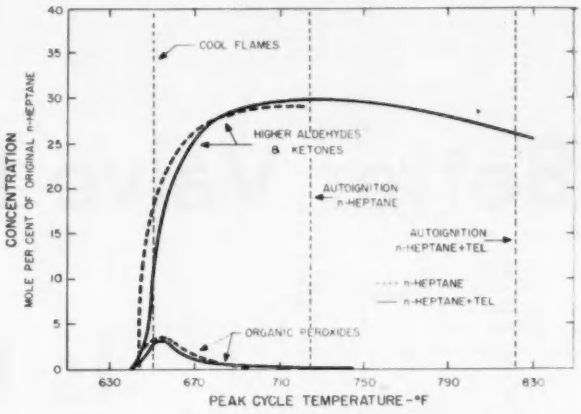


Fig. 7—Up to the point of autoignition the addition of TEL has little effect on the concentrations of total aldehydes and ketones. But TEL deactivates radicals formed by organic peroxide decomposition and blocks the chain reaction leading to autoignition and knock

with which they are blended. The addition of diisobutylene to n-heptane retards the point at which oxidation starts. It also slows the cool flame reaction so that autoignition won't occur until higher pressures are reached.

Tetraethyl Lead Acts as an Antiknock

We've known for a long time that the addition of TEL to a hydrocabon fuel will reduce its knocking tendency. It will displace the autoignition limits to regions of higher temperatures and pressures, as shown in Fig. 6. But we are not sure how TEL does this.

Evidently tetraethyl lead is selective and influences specific precombustion reactions rather than the whole oxidation process. Fig. 7 shows that the addition of TEL has little effect on the point at which the cool flame appears, on the total concentration of aldehydes and ketones, or on their rates of formation. Up to the point of autoignition the curves for both leaded and unleaded fuels are almost identical.

But, it's significant that hydrogen peroxide is almost completely eliminated. We may assume that in n-heptane oxidation, TEL does not interfere with the reactions leading to the formation of organic peroxides or with the decompositions of these peroxides. But it does stop the chain reaction leading to hydrogen peroxide formation and ultimately to knock. It probably does this by *deactivating* the radicals formed by the decomposition of organic peroxide.

This theory can be proved by an experiment using hydrogen as an engine fuel. The addition of TEL decreases knock. Since the radicals present can only be OH', HO_2', and H', the lead must attack them.

One more point may be brought out. We know that TEL decomposes early in the engine cycle, so that little of it exists when the antiknock action is occuring. The initial decomposition product is probably metallic lead. However, at high temperatures in the presence of oxygen, metallic lead would be expected to oxidize quickly to lead oxide. So, either metallic lead or lead oxide—if very finely divided—can act as the antiknock.

If TEL is added to a tube of stoichiometric hydrogen-oxygen mixture, its explosion temperature will be raised. When the inside of the tube is coated with lead oxide, the explosion temperature is increased considerably. A metallic lead coating, however, has no effect on the temperature. This indicates that lead oxide may be the active antiknock material.

Therefore, we may summarize: TEL is effective at just the right time in the precombustion reaction sequence. One of its decomposition products, probably lead oxide, prevents the hydrogen-oxygen radicals from combining rapidly to cause knock. But more research is necessary to resolve the identity of the antiknock species and the exact way in which it functions.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Excerpts from discussion

Mr. Sturgis brought out the following information in answer to questions during the discussion period:

(a) Tetraethyl lead decomposes and releases colloidal lead at just the right point in combustion. Experiments with lead vapor indicate that colloidal lead increases antiknock effect.

(b) The various hydrocarbons burn at different rates.

(c) There is no possibility of controlling knock reaction of pre-radicals.

(d) The specified spark advance was optimum.

(e) Lead oxide on the surfaces of the combustion chamber has little effect on knock.

Better Valve Lifter Life Is Proving Tough

VALVE lifter distress being experienced on some of the new overhead-valve V-8 car engines is proving tough to solve. So far, intensive research by both oil and car engineers has brought forth plenty of solid progress and many theories—some of them conflicting—but certainly no pat answer to the problem.

Probably the first major step in the right direction was realization that it is a complicated matter. It involves much more than just finding a better oil. Although improvements in the lubricant are certainly important, it is now quite clear that the problem also has metallurgical and design aspects that are, perhaps, even more important.

At least it seems generally agreed that only limited progress can be made by building a better oil. The real answer to the attainment of satisfactory valve lifter life appears to lie mainly in developing more suitable metals and in better engine design.

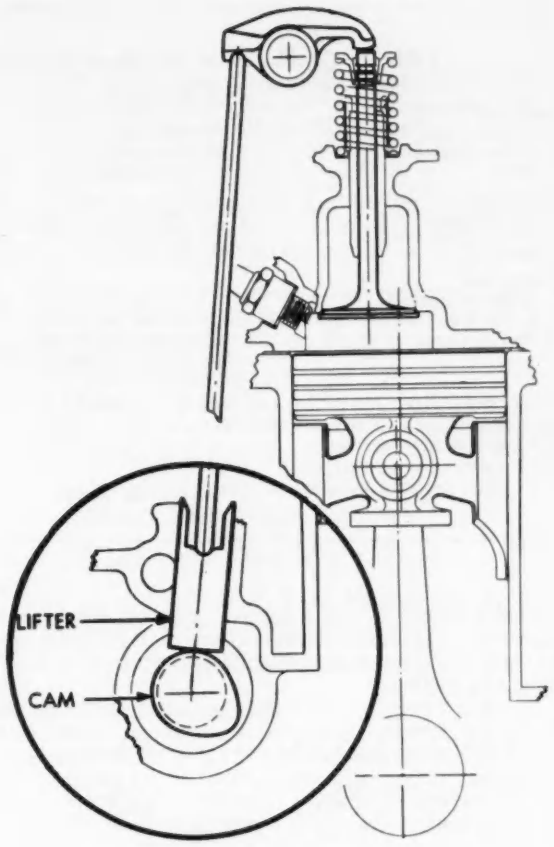
Another complication reported by several inves-

Table 1—Cams and Tappets in Overhead-Valve V-8 Passenger-Car Engines
(From Havely et al.)

Engine	Tappet			Cam			Spring Load at Cam, lb	
	Material	Crown, in.	Coating	Material	Taper Angle, min	Coating	Valve Closed	Valve Open
1	Chilled cast iron	0.0020 with ½-in. flat	Ferrox	Drop-forged steel	12.5	Parco	Intake: 112 Exhaust: 75	Intake: 229 Exhaust: 165
2	Hardenable cast iron	0.0025	Parco	Cast iron	7	Parco	162	281
3	Chilled cast iron	0.0020	None	Cast iron	7	Parco	100	225
4	Chilled cast iron	0.0040	Ferrox	Cast iron	7	None	Intake: 97 Exhaust: 92	Intake: 248 Exhaust: 248
5	Carburized steel	0.0015	Parco	Cast iron	6.5	None	92	210
6	Chilled cast iron	Flat	Ferrox	Forged steel	None	None	93	216
7	Chilled cast iron	0.0040	Ferrox	Cast iron	7	None	80	214
8	Hardenable cast iron	0.0040	Parco	Cast iron	7	None	80	214

to Attain

Here is where the trouble lies ⟶



tigators is that laboratory tests used to evaluate the effects of changes do not always correlate well with field test results.

Problems and progress on these four aspects of the subject will be outlined here, namely:

- Lubrication.
- Metallurgical.
- Design.
- Laboratory versus field tests.

Lubrication Aspects

Today eight different overhead-valve V-8 engines are being built for passenger cars. As shown in Table 1, these eight engines employ seven different metallurgical and surface treatment combinations. The sensitivity of some of these combinations to lubricating oil characteristics has made it impossible, so far, to develop one lubricant to satisfy them all.

As Yowell pointed out, we may find, for example, that the lifters of engine X thrive on oil B and are unhappy with oil C. The lifters of engine Y, on the other hand, may react completely opposite to these two oils.

Such paradoxes as these are encouraging intensive research into the causes, conditions, and immediate consequences of valve lifter wear and how it is affected by lubricating oil composition. This work has not yet proceeded far enough to have produced many definite conclusions. There appears, however, to be general agreement on a few points, such as:

1. Increasing the oil viscosity means some reduction in wear and pitting, but little change in the scuff rating.

2. Undoped mineral oils are generally unsatisfactory for this job.

The second of these statements clearly implies that something must be added to the base oil to make it satisfactory for lubricating valve lifters.

Here's where the difficulties really begin. Thus, detergents, oxidation inhibitors, and extreme-pressure (anti-wear) agents may exhibit no effect, may promote wear, or may reduce it, depending on their chemical structure. Moreover, a formulation suitable for one lifter-cam metal combination may be completely unsatisfactory for another combination.

For example, some sulfur-phosphorus additives give excellent protection from scuffing with steel tappets on hardened cast-iron cams, according to Havely et al., whereas others were actually poorer than the base oil.

In addition, they found two different proprietary detergent-sulfur-phosphorus compound combinations that, when tested on Ferrox-treated chilled cast-iron tappets with hardened cast-iron cams, re-

Table 2—Correlation of Metallurgical Data Obtained by Authors on Three Lifter Materials

	Ambrose-Taylor	Havely et al.[a]	Bidwell-Vermaire
Wear on:			
Hardened Cast Iron	Least	[b]	Least
Chilled Cast Iron	Almost as little	[b]	Medium
Steel	Excessive	[b]	Most
Scuffing on:			
Hardened Cast Iron	None	Yes, under certain conditions	[c]
Chilled Cast Iron	None	Yes, often led to cam lobe wear	[c]
Steel	Yes, always led to cam lobe wear	Yes, seldom led to cam lobe wear	Most
Pitting[d] on:			
Hardened Cast Iron	None	Yes, under certain conditions	None
Chilled Cast Iron	Excessive with some oils	Yes	Slight
Steel	Excessive with some oils (excessive spalling sometimes led to damaged cam lobes)	None	Excessive

[a] Parco-treated hardened cast iron is considered by Havely et al. to be easiest to lubricate, steel intermediate, and chilled cast iron to be most difficult.
[b] Did not measure wear.
[c] No data given in paper.
[d] Called spalling by some authors.

duced scuffing in some cases but increased pitting. However, the right combination of detergent and sulfur-phosphorus additive did eliminate both scuffing and pitting.

Similar results were obtained by these same investigators with phosphorus additives: some were good with steel and hardened cast-iron lifters, some were not. They were unsatisfactory as far as scuffing was concerned when used with the chilled cast-iron tappets, although no pitting was experienced.

Bidwell-Vermaire tested one phosphorus additive —zinc dithiophosphate—rather extensively, and got different results with material obtained from two different sources. They presented data indicating it does not promote pitting. However, their tests of commercial oils containing it as one additive component showed it was not able to prevent lifter pitting when used in the usual concentrations in combination with some detergents.

One finished oil that they found to have desirable wear and pitting qualities contained a sulfonate detergent with the zinc dithiophosphate inhibitor.

These investigators found that additives of the phenate type produced the greatest pitting of those they tested. These additives are used in several commercial oils.

Other additives found to be generally unsatisfactory by Havely et al. were sulfur, chlorine, lead, combinations of chlorine and lead, and also esters of carboxylic acid. Carboxylic acid additives tested on steel and hardened cast-iron lifters did, however, appear to give rather effective protection against scuffing.

Metallurgical Aspects

As shown in Table 2, there is a fair degree of correlation among the results reported in the three papers.

There are also some rather startling discrepancies. Note, for instance, that scuffing of steel lifters in the Ambrose-Taylor tests, always led to wear of the cam lobes. Havely et al. found, on the other hand, that scuffing of steel tappets seldom led to worn cam lobes.

Similarly, hardened cast iron and chilled cast iron did not scuff in the tests conducted by Ambrose-Taylor, whereas Havely et al. did obtain scuffing with these materials under certain conditions. Moreover, the scuffed chiled iron lifters often led to cam lobe wear.

There was also not too much agreement in regard to pitting. Ambrose-Taylor and Bidwell-Vermaire experienced no pitting with hardened cast iron, whereas Havely et al. reported some under certain conditions.

How are these differences to be explained? The answer lies in differences in test conditions, lubricants used, variations in analysis, microstructure, processing, and design. As Raviolo pointed out, these differences can produce a complete reversal of any conclusions about which material is best.

Steel lifters showed up poorest in the Bidwell-Vermaire tests, for example, because the test conditions used were adverse to steel. When run with suitable lubricants, the authors pointed out, steel lifters may be found to be superior to those made from other materials, giving long service life.

The complexity of the problem can be illustrated by the Ambrose-Taylor observation of cam lobe wear whenever steel lifters scuffed. They theorized that this wear might have been caused by excess cementite formed in the lifters during the carburizing process. They figured that if sufficient cementite is present to cause rapid wear, and if the lubricating oil permits the softer metallic constituents in the lifter surface to be worn away preferentially, the cementite would be exposed—as in relief polishing—so it could act as an abrasive.

This theory was challenged by Raviolo, who reported excellent results with steel lifters specially processed to give a considerable concentration of cementite in a matrix of martensite and austenite.

Although chilled cast iron did not show up too well in these tests, it is now preferred by some engi-

neers, according to Bryan. He reported that the original combination was carburized steel tappets and forged steel camshafts.

Chilled cast iron cannot be surpassed when steel camshafts are used, according to Scherger, who also reported on the effect of a camshaft material change. The problem arose when failures of cams and lifters in an early model of V-8 production engine were traced to edge riding, caused by hollow grinding of some cams, which left the sides of the cams high. This condition was aggravated by casting techniques, which permitted wide variations in cam locations. Correcting these faults reduced the number of failures, but did not eliminate them entirely. Scuffing of the cams at the nose appeared to be the starting point of the failure. This was transferred to the lifter face. The next step was a complete loss of valve lift. The failure was practically eliminated, according to Scherger, by changing the camshaft material from cast iron to steel. In every case where a lifter had failed with the cast-iron camshaft, the cam had also failed. With the steel camshaft, on the other hand, the lifters could be replaced unless the car had been operated too long with the spalled lifters.

Unhardened iron was suggested as a cam lobe material by Raviolo. He pointed out that the hardening process itself introduces variables that are difficult to control, although his company has had considerable success with hardened cast iron, which was used by Havely et al. in most of their tests.

Design Aspects

Many design factors are known to affect the severity of lifter operation. According to Bidwell-Vermaire, shape of lifter foot, shape of cam profile, cam to lifter offset, and valve spring load play important parts, although the exact magnitude of their effects is unknown.

The wide variety of designs used for camshafts and valve lifters in the 1953 engines indicates, they point out, that no universally accepted solution to the lifter problem has yet been found. Both crowned and flat lifter faces are used. The crowned lifter with a tapered cam assures positive lifter rotation, reduced sliding velocities, and less severe alignment problems, at the expense of increased stress.

Alignment has sometimes been proposed as the major factor in promoting lifter fatigue when a flat lifter face is used on a straight cam. This did not appear to be the case in the car and dynamometer tests conducted by Bidwell-Vermaire.

Lifter rotation is also related to the life of these parts, although exactly how is not yet entirely clear. In one of the engines used by Bidwell-Vermaire, lifters frequently did not rotate. When rotation did not occur, lifters did not pit. There was some wear on the lifter face and a groove would be worn on a diameter. With this design pitting could occur, they reported, if the lifter did happen to rotate. The least wear in all of the combinations they tried occurred in this engine with hardened cast-iron lifters. However, wear with this same lifter material was also small in the other two engines they used in their tests.

Tappet rotation is definitely undesirable, according to Bryan, because the increased shearing stress and throw-off action make the formation of an oil film difficult. He told of one application where a 0.001-in. cam taper is used. The endurance of these tappet faces is much inferior to that obtained with the untapered cam design.

Reducing the valve spring loading, where possible, seems to improve valve lifter life materially. As a matter of fact, Scherger found that if spring loads were reduced sufficiently, lifter failures were eliminated. However, with this condition valve clatter occurred below the desired top engine rpm. A redesign of the cam contour permitted a reduction in valve-open spring load of approximately 30% with no sacrifice in power or in valve clatter speed. According to Scherger, this reduction in spring load reduced the number of valve lifter and cam failures to the point where they were negligible, especially when good oils were used.

He also got increased lifter life with a reduction

THIS article is based on a group of papers and discussions presented at a "Symposium on Cam and Tappet Wear Problems":

Papers:

***"Wear, Scuffing, and Spalling in Passenger-car Engines,"* by H. A. Ambrose and J. E. Taylor,** Gulf Research & Development Co.

***"Influence of Lubricant and Material Variables on Cam and Tappet Surface Distress,"* by T. W. Havely, C. A. Phalen, and D. G. Bunnell,** Shell Oil Co.

***"Lifters and Lubricants,"* by Joseph B. Bidwell,** GMC Research Laboratories Division, and **Paul Vermaire,** GMC Diesel Equipment Division.

Discussions by:

T. A. Scherger, Studebaker Corp.

V. G. Raviolo, Ford Motor Co.

R. E. Crosthwait, E. A. Martin, and J. F. Socolofsky, Socony-Vacuum Laboratories

H. L. Yowell, Standard Oil Development Co.

W. S. James, Fram Corp.

H. F. Bryan, International Harvester Co.

The Symposium was held at the SAE National Passenger-Car, Body, and Materials Meeting, Detroit, March 2, 1954.

All three papers plus complete discussion are available in multilithographed form from SAE Special Publications Department as SAE-127. Price: $1.25 to members, $2.25 to nonmembers. Papers plus discussion will also appear in full in the 1955 SAE Transactions.

Table 3—Laboratory versus Field Lifter Wear—
Engine X, Chilled Cast-Iron Lifters
(from Yowell)

	100-Hr Cyclic Laboratory Test		6000-Mile Field Test	
	Lifter Wear, in. × 10^4	No. of Lifters Spalled	Lifter Wear, in. × 10^4	No. of Lifters Spalled
Oil A	56	0	25	13
Oil B	19	1	13	0
Oil C	14	0	49	0

in cam nose radius. The original cam nose radius of 0.264 in. was changed to 0.176—which, theoretically, should produce a higher stress than the smaller radius. Actually, this change reduced scuffing tendency on both cam and lifter, especially with the steel camshaft.

Laboratory versus Field Tests

A great variety of laboratory tests have been used to study valve lifter wear because they can be performed quickly and at less expense than field tests. These include both full-scale engine tests, chassis dynamometer tests, as well as a variety of bench tests—Timken, Falex, four-ball, and the like.

The value of at least some of these test procedures was questioned by Yowell. In his experience, correlation of lab engine tests with field tests has not been too good.

For example, Table 3 (taken from Yowell discussion) shows that engine X, equipped with chilled iron lifters, gave lifter wear of 0.0056, 0.0019, and 0.0014, respectively, for oils A, B, and C in a 100-hr cyclic engine test. These same oils were field tested for 6000 miles in an automobile equipped with engine X. Driving consisted of about 50% city stop-and-go driving and 50% mild intercity driving. Top speed was 45 mph, and the average was 22. Under these conditions, the values for these three oils were 0.0025, 0.0013, and 0.0049 in., respectively. Note that in two out of the three cases, the field wear was less than in the lab engine test. Also note that oil A gave no evidence of spalled lifters in the lab test, whereas 13 of the lifters spalled in the field test. This spalling did not increase the lifter wear.

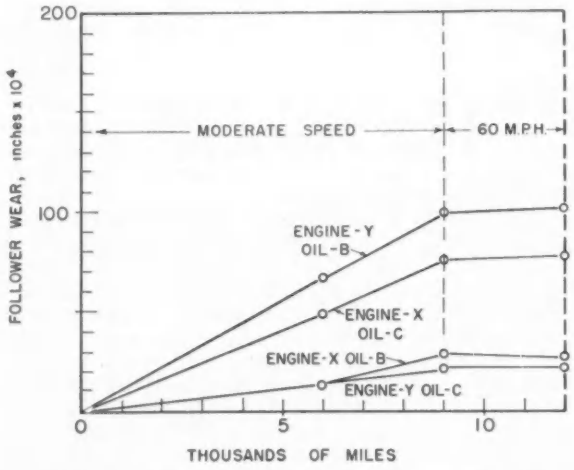


Fig. 1—At moderate driving speeds, lifter wear increased linearly over a distance of 9000 miles; when driving speed was increased to 60 mph, there was essentially no further lifter wear (from Yowell)

Similar doubts were expressed by Crosthwait et al. concerning the usual bench tests for wear and e-p properties. They found these tests of little value in predicting valve train wear results.

Raviolo had some doubts, in particular, about the validity of test techniques using overloaded springs. In an area as undefined as this one, he said that he was suspicious of any attempt to accelerate the test by changing the design condition, when the effect of the change is not clearly predictable. He reported, though, that Ford is also using the technique, with an eye to its significance in future design conditions.

Although Ambrose-Taylor got what they considered reasonably reproducible results relating viscosity and composition with wear on the four-ball machine, none of the bench tests correlated with spalling or fatigue-pitting of valve lifters.

Limitations of standard bench tests were also pointed out by Havely et al. They reported that such tests may give misleading information in regard to the ability of the oils to prevent scuffing and pitting.

This is not surprising, they explained, since none of the standard bench tests use the same combinations of metals as the engines—and the lifter and camshaft materials do have a large influence on what happens in service. They suggest that if the test metals were changed to conform to those being used in the engines and the test techniques modified, a satisfactory bench test might be established.

Another difficulty with any test is that driving conditions have a marked effect on lifter wear. Yowell points this out with the aid of Fig. 1. At moderate driving speeds, the lifter wear increased linearly over 9000 miles. When driving speed was increased to 60 mph, there was essentially no lifter wear. This was true whether or not the lifters had shown any marked tendency to wear under the moderate-speed driving conditions.

Bidwell-Vermaire have developed a simple test procedure, which produces results in a short time. This procedure correlated oils with respect to their ability to provide boundary lubrication and inhibit fatigue of the lifter face. Boundary lubrication was studied because they have found that the parts operate under this condition at least part of the time.

Checks of this procedure with service results were reported to show that oils demonstrating superior performance in the laboratory tests are superior in service. Similarly, oils that perform poorly in the lab tests also performed poorly in cars.

To use this test to study a variety of lifter-camshaft materials, they warn that it is necessary to determine the most difficult operating condition for each material combination. Otherwise, the results are likely to be most misleading.

New Injector Simplifies Diesel Fuel System

J. W. Rowell and C. R. Boll, Cummins Engine Co.

Based on paper "The New Cummins PT Diesel Fuel System," presented at the SAE National West Coast Meeting, Los Angeles, August 16, 1954.

A RECENTLY developed fuel injector makes possible a more simple, lower cost, easier to maintain diesel fuel system. Its unique design results in three features which make the Cummins PT fuel system different from any previous systems:

(1) The injector, besides shooting fuel into the cylinder, also takes on the fuel metering function. This makes for a simpler fuel pump.

(2) The fuel flow from the pump to the injector is continuous, hence the pump does not have to be timed with the engine.

(3) The system has eliminated high pressure check valves and many other parts. Therefore, it is less expensive and less troublesome.

The Cummins PT fuel system gets its name from the fact that fuel is metered through an orifice in the injector. Since the amount of fuel passing through a fixed orifice is a function of the pressure and time, the system was called the PT (pressure-time) system.

Fig. 1 is a cutaway section of the injector showing the fuel injection cycle. Fuel under continuous pressure from the pump enters the passage at the right. During the power, exhaust, and a portion of the intake strokes, the plunger remains seated, cutting off the flow of fuel at point A.

On the intake stroke of the engine piston, the plunger begins to retract, uncovering point A, and allowing fuel to circulate around the injector and up the drain passage at the left. As the plunger continues to rise, a metering orifice, B, is uncovered and fuel flows through it into the cup.

When hole A is open, but hole B is closed, fuel circulates around the injector and returns to the tank. But in passing through the injector the fuel absorbs heat and minimizes fuel freezing during cold weather. This continuous flow also makes the system self-purging of air, and no priming is necessary.

It's obvious that the amount of fuel delivered through B is increased when the pressure is increased and decreased when the pressure is decreased. However, since the time interval available varies inversely with the rpm of the engine, a pump is necessary to produce the proper ratio of pressure at various engine speeds. Also, the pump changes the pressure—and consequently the fuel charge—in response to the throttle and governor.

Since the fuel metering function has been transferred to the injector, the fuel pump merely controls pressure and delivers adequate quantities of fuel. Thus the pump is greatly simplified.

A schematic diagram of the PT fuel system and its components is shown in Fig. 2. Actually six of these components—the gear pump, strainer, pressure regulator, throttle, governor, and shutdown valve, are combined into one housing called the PT fuel pump. (Fig. 3)

The **gear pump** (Fig. 4) picks up the fuel from the tank and builds up the pressure and flow for the

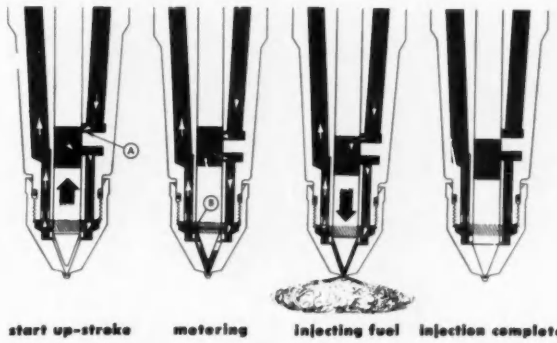


Fig. 1—Fuel injection cycle. The injector, besides shooting fuel into the cylinder takes on the fuel metering function.

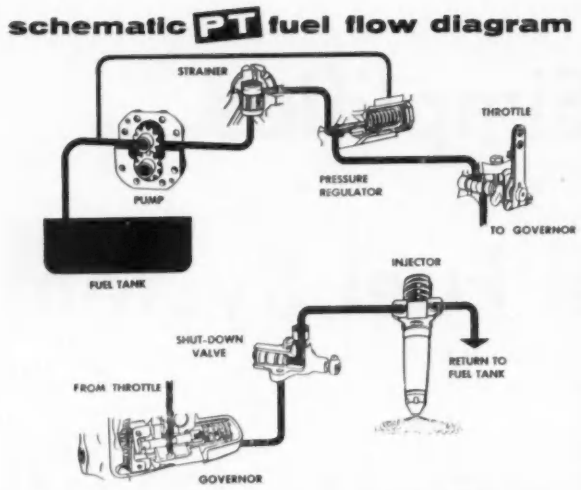


Fig. 2—This is a fuel flow diagram of the Cummins PT Fuel System. The pressure regulator, throttle and governor are shown in full horsepower operating positions.

entire fuel system. It has a large capacity so that the same gear pump can be used for various sized engines. It's driven through a shear pin arrangement so as to protect the remainder of the PT fuel system in case of damage to the gear pump.

The fuel flows from the gear pump through the **strainer** into the **pressure regulator** chamber. This chamber is connected to the throttle shaft by a drilled passage. In the stop position, holes A, Fig. 5, are covered. However, as soon as the engine is started, sufficient pressure is built up to move the regulator to the right, uncovering holes A. This allows surplus fuel to by-pass through the holes back to the suction side of the pump.

Fig. 6 shows the pressure and speed chart for a typical PT fuel pump. Line X shows the pressure and speed relationship of the gear pump itself. Pressure on the fuel system through the regulator follows this line until the small by-pass holes are uncovered at the engine's idling speed. By-passing the fuel through these holes compensates for the increased pump delivery as speed increases. Fuel pressure, under control of the pressure regulator and idling governor, is nearly constant for several hundred rpm in the idling range.

When the throttle is opened and the main ports in the governor barrel are uncovered, the increased fuel going to the injectors causes an immediate increase in engine rpm. Then pressure at full throttle increases along line Y. This line represents the pump delivery with holes A fully open and forming a constant by-pass.

The pressure and speed relationship (and consequently engine torque and hp) is further controlled by by-passing additional fuel through the second small holes, B. As speed and pressure increase these holes move to the right until they are uncovered and fuel can pass through. They are located to begin by-passing additional fuel at a certain predetermined pressure near the speed of maximum engine torque. For example, we get a curve like the top end of that shown on line Z, Fig. 6. By changing the location of the holes we could begin dumping at at lower or higher rpm, thus changing the shape of the curve.

When the engine reaches governed speed, the governor shaft begins to restrict the flow and increases the pressure in the regulator chamber until hole C is uncovered, by-passing more fuel. When the throttle or governor is completely closed all fuel

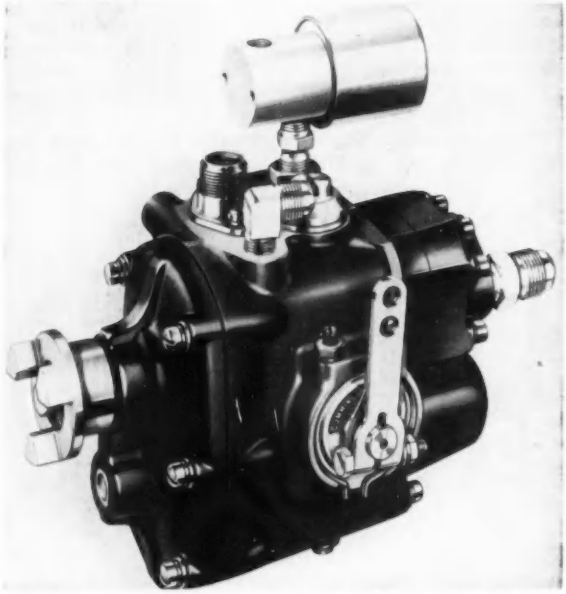


Fig. 3—The new Cummins PT Fuel Pump combines the strainer, pressure regulator, throttle, governor, and shut-down valve in one housing.

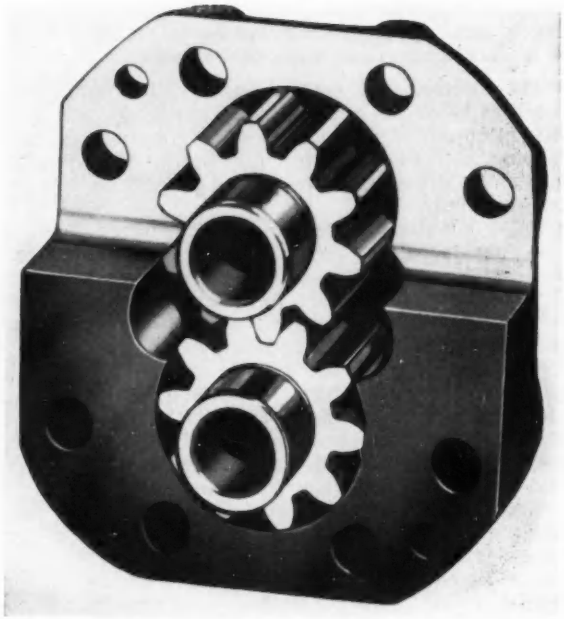


Fig. 4—The gear pump picks up the fuel from the tank and builds up the pressure and flow for the entire system.

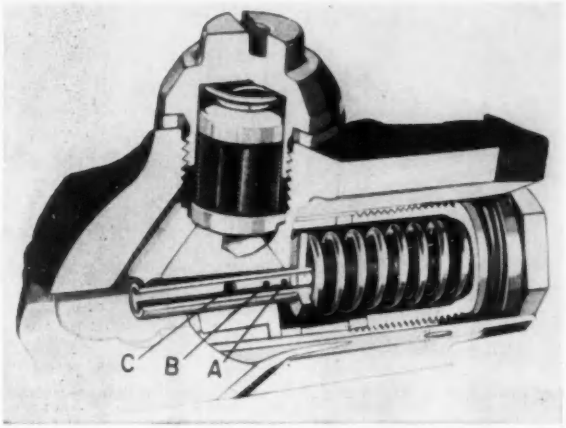


Fig. 5—The pressure regulator controls the amount of fuel by by-passing it back to the tank.

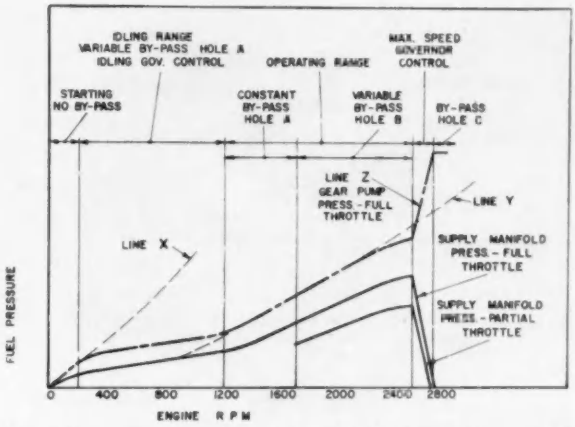
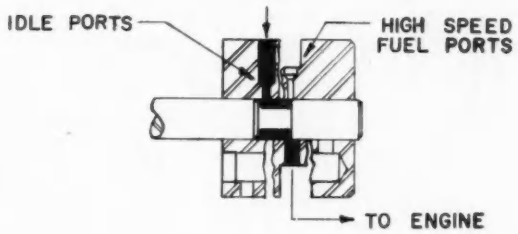
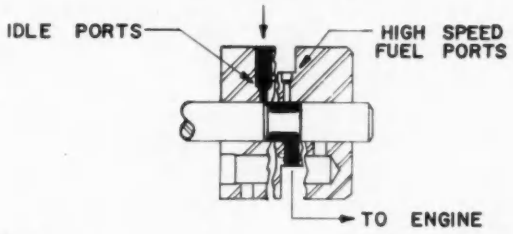


Fig. 6—Pressure-speed chart for a typical PT Fuel Pump. The manifold pressure curve is parallel to, but less than, the gear pump curve (x) due to line restrictions between the regulator and the fuel manifold.

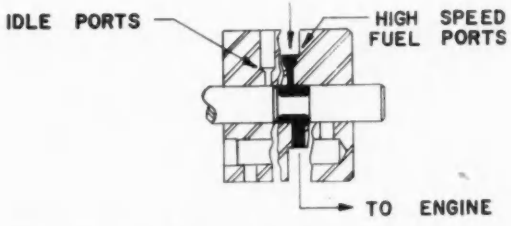
How the Governor Works



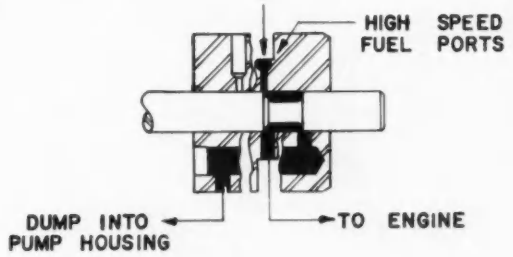
1. As the engine is cranked, fuel can flow through either the idling or high speed ports, depending upon the throttle position.



2. As the engine starts and reaches idling speed with the throttle closed, the shoulder on the governor shaft partially closes the idling port and controls the pressure in the manifold.



3. As the throttle is opened fuel begins to flow through the high speed ports. This increases engine speed. This speed increase causes the governor weight to move the governor shaft and close the idling passages. Fuel pressure is now under control of the throttle.



4. When the engine reaches governed speed, the governor shaft moves further and covers a portion of the high speed ports.

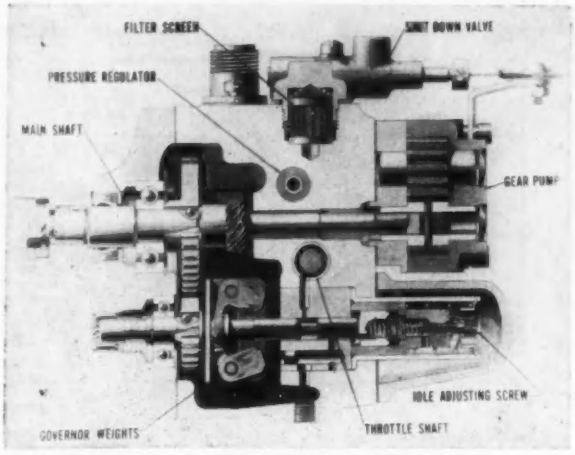


Fig. 7—Cross section of the PT Fuel Pump showing the arrangement of the governor, throttle and gear pump.

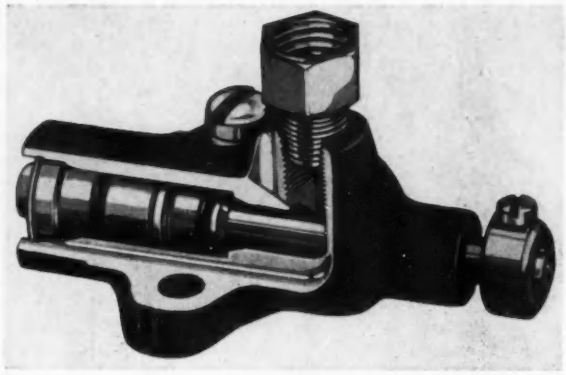


Fig. 8—This is a manual shutdown valve. Some models are solenoid actuated.

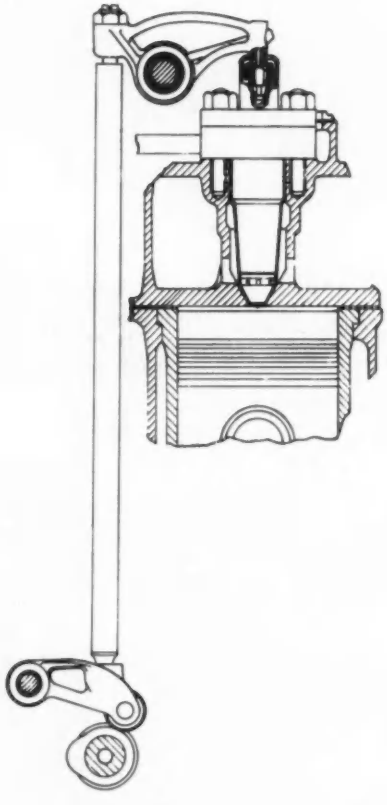


Fig. 9—Injector actuation showing linkage from the engine camshaft.

is recirculated through the gear pump. Under this condition no fuel is being delivered to the injectors, thus allowing the engine to produce maximum braking effect.

The governor is a mechanical flyball working against a small idling spring and large high speed spring as shown in Fig. 7. Instant response to the governor is an important feature of the PT system.

The engine shutdown valve is shown in Fig. 8. This view shows the valve in operating position. The fuel passes to the left of the valve and to the fuel manifold and injectors. In the off position the valve and seal moves to the right cutting off all flow to the injectors. This control can be hand operated or solenoid actuated.

A push tube and rocker arrangement (Fig. 9) operated by the engine camshaft times the injector plunger. The fuel pump of the PT system serves only as a source of fuel and pressure. Hence, it need not be timed to the engine.

The simplicity of the PT fuel system can be pointed up by comparing it with other systems. The pump weighs only 13 lb. Previous Cummins pumps weighed 104 and 33 lb. The total number of parts has been reduced from over 400 to 182. This makes for lower manufacturing costs, easier trouble shooting and lower maintenance costs.

The PT fuel system gives low fuel consumption at all loads and speeds. It operates efficiently at very high speeds. It gives the engine an acceptable torque curve and good idling characteristics. Also, the system is adaptable to previous Cummins diesels.

Systems are now available throughout the world and exchange programs on both pumps and injectors, providing an economical conversion of old engines, have been established. The Cummins PT Fuel System is now standard equipment on all Cummins Diesels built since July 1, 1954. (Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

CRC IN '54

ONE-HALF of the CRC projects are now being carried on for industry.

With the start of the war in Korea, the emphasis on military projects within the CRC continually increased until the fall of 1952, at which time it reached a peak. Approximately 70% of the CRC investigations were either being carried out at the express request of the military services or were activities in which they had expressed a definite interest and to which they were contributing support. During the past two years, this general trend has changed.

Now the number of active projects which were initiated by industry equals the number initiated by the military services. This change has been due to two factors: (1) the gradual development of increased industry activity, and (2) the tendency to reduce the number of military projects.

The CRC is currently working on 42 individual projects dealing with 35 separate subjects. Work on 11 individual projects, representing eight new subjects, an amplification of one subject, and two projects which are carried out on an annual basis, was initiated during the past year.

Work on 21 projects has been completed, or completed except for the release of a final report, since the issuance of the 1953 Annual Report.

CRC technical reports, prepared during the progress of work or upon completion of a project, are released by the appropriate CRC Committee to the Sustaining Members for publication or general distribution. An arrangement has been effected with the American Petroleum Institute and the Society of Automotive Engineers, Inc., for distribution of released reports. Lists of all available CRC reports are published periodically in the SAE Journal.

A short review of some of the projects being carried on by the Coordinating Fuel and Equipment Research Committee and the Coordinating Lubricant and Equipment Research Committee is given below.

Fuel and Equipment Research

The study by means of high-speed photography of combustion inside the combustion chamber of an internal combustion engine has been finished. A report on this three-year project is being released to the Sustaining Members. This project was initiated at Battelle Memorial Institute. It was planned that, by utilizing the "know-how" of Dr. C. D. Miller and the high-speed camera at Battelle, valuable technical information on combustion could be made available.

A great deal of time was spent on developing the equipment for the work, and a technique has been developed whereby simultaneous photographs of the direct flame from the engine, together with the schlieren image of the flame, have been taken under a number of conditions.

The development of a technique for the measurement of instantaneous temperatures within the combustion chamber of an operating Otto-cycle engine is being carried on at the Massachusetts Institute of Technology and the University of Wisconsin, with the financial support of the Office of Ordnance Research. The first year's work involved a study, supported by CRC, by four universities of the various techniques which might be used for this purpose. The sound-velocity technique developed by the Massachusetts Institute of Technology and the absorption technique developed by the University of Wisconsin were considered to be practical approaches. Their further development was recommended. The second year's work is being supported by the Office of Ordnance Research.

The petroleum industry and the equipment in-

dustry, because of their direct interest in this project, have agreed to joint support from the Military Services and industry for the third year of this work. One-half of this support coming from the Military Services and the other half contributed jointly by the petroleum industry and the equipment industry. The sound-velocity technique developed by the Massachusetts Institute of Technology and the absorption-spectra technique developed by the University of Wisconsin have now both been developed to the point where actual temperature measurements have been taken inside the cylinder of an operating Otto-cycle engine. Instrumentation is being refined and it is felt that further development of these techniques will permit the devices to be used as laboratory tools in combustion research studies.

At the request of the Office of the Chief of Ordnance, an extensive program has been carried out studying the storage stability of aviation fuel, motor fuel, and jet and diesel fuel. This project was designed to establish whether the current tests for predicting storage stability could still be relied upon with the advent of the new refining techniques, particulary when considering the extreme severity of the conditions of military storage.

Desert storage tests have been under way for a little more than two years. Based on the information which is available, it appears desirable to conduct a fundamental study of the basic mechanism of fuel storage stability. Proposals for this type of research from a group of university and research laboratories were studied. The recommendation was made to the Ordnance Corps that the research proposals of the Bureau of Mines, Bartlesville, Oklahoma, which were concerned primarily with an analytical study of gum formation, and of Stanford Research Institute, which covered a more fundamental study of stability as a whole, be supported.

The CRC will provide assistance in an advisory capacity to the Ordnance Corps in monitoring the research at these two organizations. The desert storage program will be completed this year, with the possible exception of the supplementary short-range program which was initiated this past year to study the effects of storage conditions and a range of fuel composition variables on storage stability.

The Coordinating Research Council early this year received a request from both the automotive industry and the petroleum industry to initiate a study of the composition of the exhaust gas of automotive vehicles. In response to this request, the Coordinating Fuel and Equipment Research Committee has established a Group to determine the composition of automotive exhaust materials and the independent effect on exhaust gas composition of engine design and condition, operating conditions, and fuel and lubricant variables.

The scope will include the development of techniques for the sampling and analysis of materials emitted from the exhaust pipe, including crankcase breather openings, from gasoline and diesel internal combustion engines for ground vehicles. The work will include (a) determination of oxygen, hydrogen, carbon, sulfur, and nitrogen oxides, water vapor, and total other combustibles in the exhaust gases as a percent of the original fuel-air mixture, (b) determination of the classes of organic compounds in the unburned combustibles, and (c) to the extent possible, the determination of the specific identity of the chemical compounds in each class.

To carry out this objective three separate activities have been initiated: a study of techniques for sampling and analysis of the exhaust gas, a study of the effect of engine, fuel, and lubricant variables on exhaust gas composition, and a literature survey of the problem.

The work of the CFR Aviation Fuels Division is entirely concerned with the subject of gas turbines and their fuels. Because of increasing interest in the commercial utilization of gas turbines in aircraft, each of the aviation fuel projects has been reevaluated to insure that consideration has been given to the inclusion in the test programs of fuels that might be considered for commercial use.

The vapor-locking characteristics of gas turbine fuels, fuel evaporation in tanks during flight, and fuel-tank pressurization required to prevent excessive fuel losses, continue to be studied by the Aviation Fuels Division. Because of the increasing speeds of military and civilian aircraft, with their corresponding increases in skin and fuel temperatures, the previous work is being extended to cover a wider range of fuels and a wider range of temperatures and pressures.

The study of low-temperature pumpability has demonstrated that, with proper housekeeping to eliminate excess water from the fuel at the time of aircraft servicing, the filter-icing problem is essentially eliminated. It has been determined that water in solution at the normal temperatures of fuel servicing and at take-off will precipitate out when the temperature is reduced as in flight. With proper ventilation, this excess water may be withdrawn and vented overboard without causing icing difficulties, but water may also condense upon descent through a humid atmosphere and possibly cause trouble.

A proposed flight test schedule has been prepared, by which individual organizations can determine whether or not their equipment is subject to icing difficulties. An over-all engineering report covering all the work on this subject is being prepared for release.

The proposed program to study high-rate fuel flow in turbine powered aircraft has been delayed, pending installation of special test equipment at Wright Air Development Center where the tests are to be conducted. The CRC will supply advisory assistance in the conduct of the test and the analysis of the data.

Because of the proposed use of air to transfer fuel within the airframe, the problem of air-gas solubility has been proposed. The Air Force is conducting experiments to measure the air-gas solubility under static conditions. It has been proposed that a program be drafted to study the air-gas solubility under dynamic conditions.

Two programs on the combustion characteristics of gas turbine fuels are under way, with the objective of developing a test or tests which will provide significant and relatively simple means of evaluating combustion characteristics of gas turbine fuels with several parameters, such as combustion efficiency, flame velocity, quenching distance, and minimum ignition energy.

The second and more active program is the study of the carbon-deposition problem. Tests have been

carried out on full-scale burners, full-scale single tubes, small-scale burners, and various bench tests. Emphasis has been placed on covering a range of combustion design and operation. However, it has become evident that, with rapid changes in full-scale engine combustion design, the laboratory test equipment must be modified to provide operating conditions more in line with those in the full-scale engine.

An Aviation Fuels Division Conference was held in Los Angeles this spring. A summary of the CRC information which had been developed in the field of aviation fuels was presented to the airframe manufacturers.

It has been recommended that CRC groups, composed of airframe industry and petroleum industry personnel, be organized on the West Coast to work on mutual problems, rather than having all of the activities concentrated on the East Coast. It is believed that this procedure will encourage participation and support from the airframe industry.

The full-scale railroad diesel fuel program of the CFR Diesel Fuels Division, designed to study the effect of the use of high-sulfur, low-cetane-number, high-end-point diesel fuel on locomotive operation is now nearing completion. A progress report covering the tests on six railroads which have been completed has been prepared and distributed to the sponsoring organizations.

Two additional tests involving heavy-duty freight operation of Baldwin locomotives on the Pennsylvania Railroad and Alco locomotives on the Chicago and North Western Railroad are still to be reported. The actual test work on the Pennsylvania Railroad has been completed and the data are being analyzed. The tests of the Alco locomotives on the Chicago and North Western Railroad have just been started and will be completed in approximately one year. When these two tests are completed, a final report, covering all the tests, and including the additional work done on smaller full-scale automotive-type diesel engines, and the detailed analytical work done by the U. S. Bureau of Mines, will be prepared.

The constant-volume diesel fuel bomb project being carried on by the U. S. Bureau of Mines at Bartlesville, Oklahoma, is being extended to cover a three-year period. The results of this work to date have indicated that accurate reproducible results with a wide variety of diesel fuels can be obtained. Also the bomb is a useful and significant test tool for use in the laboratories of both the automotive and petroleum industries for studying diesel fuel combustion.

To permit a better programming of test work and to insure a continuity of test personnel at the U. S. Bureau of Mines, a program has been developed to cover a three-year period. This program will include the testing of a wide range of pure hydrocarbons and blends of hydrocarbons, as well as selected cuts of commercial fuels, together with a study of certain operational variables in the bomb.

At the request of the U. S. Navy Bureau of Ships, a Panel of the CFR Diesel Fuels Division is serving in an advisory capacity to the Navy in the programming of full-scale submarine engine tests being run at the U. S. Naval Engineering Experiment Station, Annapolis, Maryland. This test program will evaluate fuels from foreign sources, which might have relatively high sulfur content, and which the Navy might have to use in the event of an emergency, for use in submarine engines under the emergency operating conditions involving snorkelling for long periods of time.

In addition to the various fuel characteristics, lubricating oils, engine operating conditions, and a series of engine design factors are being studied. The data to date have shown that marked improvements in engine durability can be obtained. Another Diesel Fuels Division Panel is studying the range of fuels which might be involved, and the effect of these fuels on the performance of small-craft propulsion engines being used by the Navy.

The significance of the cetane number of a diesel fuel as a measure of its ignition quality has been the subject of a study by the CFR Diesel Fuels Division Ignition Quality Investigation Group. It has been determined that, in the more critical engine operating conditions, where the ignition quality of the fuel is important, the cetane number, as determined by the currently accepted tests, is not always significant. The program being carried on covers an evaluation and modification of existing laboratory techniques, as well as the development, if necessary, of new laboratory techniques. These will indicate the effect of fuel ignition quality on full-scale engine performance in these critical areas, such as starting, warm-up, and operation under variations of speed and load.

With the increasing attention being paid to smoke in the exhaust of diesel engines, an improved smokemeter is the goal of another CFR Diesel Fuels Division Group. The present meters fail to correlate with the density of visible exhaust smoke. Several new types of meters have been tested, and it is expected that it will be possible to recommend a type of instrument more suitable for measuring smoke density.

The CRC Symposium on Combustion Chamber Deposits, held in 1952, led to the recommendation for the initiation of a new project in the CRC, the study of preignition. The standardization of terminology, a review of preignition instrumentation, and a study of preignition reference fuels will be undertaken by the Motor Fuels Division. Definitions for the basic types of combustion, including normal combustion and the various manifestations of abnormal combustion, have been prepared. The term "preignition," which has been used in a generic manner for years to describe a number of types of abnormal combustion, is now being restricted to its specific meaning. The term "surface ignition" is to be used as a generic term for these types of abnormal combustion.

These definitions, which are a major step forward in the industry understanding of the problem of abnormal combustion, were approved by the Coordinating Fuel and Equipment Research Committee and the Coordinating Lubricant ond Equipment Research Committee in June, 1954, and have been made available to industry.

The Motor Fuels Division has been assisting the Ordnance Corps in conducting octane number requirement and vapor lock tests on new Ordnance equipment at the Ordnance Climatic Test Station, Yuma, Arizona. In 1953, as a result of the CRC work, the Ordnance Corps revised its acceptance tests for new vehicles. All vehicles now must use a special vapor lock test fuel, equivalent in operation

to an 8-psi Reid vapor pressure fuel operating at 125° F, during their cooling, hill-climbing, and sand-mobility tests. Thus all vehicles which are accepted by the Ordnance Corps will have demonstrated their ability to operate with military gasoline at ambient temperatures of 125° F. Ordnance Corps personnel, during the summer of 1953, demonstrated that they could conduct this type of test without supervision or assistance from CRC personnel, and have indicated their satisfaction with the results which are being obtained.

Unless new problems in this general field arise, as, for example, the introduction of a new type of powerplant, it is expected that CRC will not be called on by the Ordnance Corps for additional work in the vapor lock and octane number requirement field. Because of the changing fuel characteristics occasioned by the increase in octane number level, it is probable that an investigation of the significance of the upper-end volatility will be carried out to complement the front-end volatility work that has just been completed. Then an over-all picture of the volatility factor will be available.

Vapor lock and the associated problems of hot stalling and hot starting in passenger cars and commercial vehicles, are being studied by the Motor Fuels Division. A very comprehensive survey of the difficulties being experienced in service throughout the United States was made, covering a total of approximately 140,000 cars. An analysis of these data is now being prepared. It is interesting to note that in more than 90% of the instances of difficulty, overheating was the offender, rather than vapor lock.

Because the results of this survey were quite different from those which had been expected by the Group, and because there was some question as to validity of the techniques used in conducting the survey, another Trouble Spot Survey will be conducted during 1954, to confirm the preliminary indications of the 1953 data. A technique was developed during this past year which permits the study of vapor lock, hot stalling, and hot starting during a single test schedule. Eleven standard 1952 or 1953 vehicles were tested at Indio, California, by this technique.

The Motor Fuels Division is continuing its yearly study of the octane number requirements of passenger cars as they are operated in the hands of the public. The 1953 Survey covered a specific study of those individual makes and models which were of particular interest because of recent engine changes, and/or transmission design changes, to determine the effect of these changes on the vehicle octane number requirement. Two hundred and forty cars were tested in this program, and 24 automotive and petroleum laboratories participated. The Equipment Survey Group of the Motor Fuels Division presented a paper on this work at the SAE National Fuels and Lubricants Meeting in Tulsa this Nov. The evaluation of part-throttle octane number requirements, which was brought to the fore with the introduction of some of the new-design cars, and the study of hill requirements, are also continuing.

The 1954 program is designed to study the octane number requirements of the new-design cars, and also to determine, if possible, the effect of age and use on the octane number requirement of individual cars. One of the important factors being studied in the 1954 program is surface ignition (formerly loosely called preignition).

Equipment Research

The interest and activity in the lubricant and equipment side of CRC work have been increasing markedly in the past few years. Increasing emphasis is being placed on wear, oxidation, and cleanliness problems. To carry out its responsibilities with this increased activity, the Coordinating Lubricant and Equipment Research Committee has reorganized itself, using the Division type of structure on which the Coordinating Fuel and Equipment Research Committee is organized.

Three Divisions have been created, the Engine Lubricants Division, which will be concerned with lubricant and engine problems; the Vehicle Lubricants Division, which will be concerned with lubricant and equipment problems in all other parts of the vehicle except the engine; and the Aircraft Lubricants Division, which will be concerned with lubricant and equipment problems in aircraft, including the aircraft engine.

The investigation of the engine-lubricant relationship in Army engines, including the Ordnance aircooled tank engine and the aircooled liaison aircraft engines, has been continuing. The aircooled tank engine tests are being run at Aberdeen Proving Ground and at the Detroit Tank Arsenal. The liaison aircraft engine tests were conducted under Ordnance contract at the Ethyl Laboratories in Detroit. Upon completion of each section of these tests, an Inspection Team from the CLR reviews the test and inspects the engine. This test work has indicated that some engine modifications are necessary for optimum performance, and these changes are being incorporated in the new engine designs. Fleet tests are also being conducted at Southwest Research Institute to study the operation of Ordnance vehicles on the various military specification oils.

The fuels and lubricants which are being used in these field test programs are being made available to the various Groups of the CLR to insure that the maximum utilization will be made of the field service data being obtained. These data will be of particular use in the development of research techniques using the CLR Oil Test Engine.

A new problem on engine oils has been presented to the CLR. The engine manufacturers have indicated that a problem of film strength or EP characteristics of lubricating oils has developed in the higher horsepower output engines now being installed in passenger cars. This problem, which has been with the industries for a long while, is showing up as excessive wear on cams, cam followers, and gears. It has been indicated that both engine design and lubricating oil have a definite effect on the problem, and that a cooperative project seems desirable. A Group has been organized to review this subject and prepare a proposed program for future work.

At the Nov. 1952, meeting of the CLR, the CLR Oil Test Engine Group was authorized to "make arrangements for design studies with suitable manufacturers, and also come up with a suitable design." Also to "complete their studies, and make a selection of an engine manufacturer to build the

engine; then come to the CLR with a definite recommendation, so that there will be no delay if the CLR approves the design." Since that time, the Oil Test Engine Group has been actively following this directive. Invitations to submit proposed designs based on the CLR Survey Team findings were tendered to six companies, all of whom were considered by the Group to be capable of satisfactorily handling the assignment. Of the six manufacturers, two companies indicated their desire to submit designs. After careful consideration of the detailed designs, the delivery schedules, and the cost estimates furnished, the Group agreed that, subject to the approval of the CLR, the proposal submitted by the Laboratory Equipment Corporation would be accepted, and the CLR, at its June, 1953, meeting, approved the action taken by the Group.

The new engine was designed to be capable of meeting the requirements set up in the survey of over forty laboratories conducted in 1952. The first batch to be made up will be used in technique development work, prior to construction of a larger number of engines for general industry use. The first pilot model of the engine was built and is now undergoing test. Preliminary test data have shown that the engine will achieve the goal established in the survey. The first batch of 25 engines, which are to be used by the cooperating laboratories for technique development, are to be delivered by the end of 1954.

The reproduction of engine deposits in the laboratory, similar to those found in actual field operation, has been the objective of one of the projects of the CLR. This study, covering a number of engine designs, piston-ring combinations, and operating conditions, is a very active project, and the results being obtained have indicated that it is possible to reproduce these deposits. The correlation between the laboratory data and results from the field test programs is not satisfactory at the present time, so that additional work is indicated.

A number of companies in the petroleum industry have indicated concern with rear axle failures in passenger cars, as indicated by surveys which they have made, and companies in the automotive industry are now checking their service information on the subject. The CLR Gear Lubricants Group, as a result, is now conducting a complete survey of all industries involved to determine the extent of the problem of rear axle failures, and to what extent the lubricant-equipment interrelationship is involved. Upon completion of this survey, a study will be made to establish whether a cooperative project should be set up in the CRC to study this problem.

A comprehensive study of airframe lubricants and bearings being carried out by a CLR Group at the request of the U. S. Air Force and the U. S. Navy. The purpose of this work is to determine the lubricant requirments of the various mechanisms built into the airplane, so that changes in both the aircraft or accessory design and the lubricant can be made to obtain the best over-all effectiveness. Included in this study are the problems of rust prevention, high-temperature operation, and fret corrosion, as well as instrument-bearing and plain-bearing problems.

One of the most important factors in this study is service test data, which it has been very difficult to obtain in the past. Extensive field test programs on a number of these problems are under way, and it is expected that adequate service information will be made available as the individual tests progress. A progress report covering the first phase of this work is now being prepared for release.

In accordance with a request received from the Air Development Force, an extensive program was initiated to study the use of compounded lubricating oils in reciprocating aircraft engines. Flight service tests were conducted by the Air Force on a series of oils in B-36 and B-50 aircraft, and a full-scale multi-cylinder engine test program, designed to evaluate over-all engine performance, was carried out by the Military Services. These data were made available to the members of the CLR Aircraft Reciprocating Engine Lubricant Performance Group. Using such research techniques as were made available, they tried to establish a series of techniques, covering such items as spark-plug fouling, preignition tendencies, etc., which would correlate with field service data. The flight tests have been completed and a report on the work is being prepared for the Military Services.

A study of the various methods by which the development of improved bearings and improved lubricants for aircraft powerplant use might be accelerated is the subject of an activity of a Group of the CLR. This study is involved particularly in the field of the large high-speed high-loaded bearings, such as are used as main rotor bearings in gas-turbine powerplants. The Group recommended that, because of the high cost of test equipment, the progress be speeded up by the Air Force making available to industry test machines for research and development work. A cooperative design for a test machine for the study of high-speed, high-load main-rotor bearing problems was developed. The Air Force hae arranged for the construction of one of these large machines and two smaller machines for general industry research and development.

General

The CRC Assignment Committee, at its Nov. 1952, meeting, approved the establishment of a joint CFR-CLR Group to serve in an advisory capacity to the Ordnance Corps in the preparation by Ordnance of a descriptive booklet on the handling of fuels and lubricants in military equipment. A general outline has been suggested to Ordnance, and tentative writeups covering two of the sections have been prepared.

In addition to CRC Groups working on specific projects, there are several Groups making very valuable contributions to the over-all CRC program by acting in a supervisory or service capacity. The CRC Report Review Group reviews all reports prepared in connection with projects initiated at the request of the Military Services, which, because of security reasons, fall in the classified category, and approves them for official transmittal. The CRC Editorial Group reviews and clears all CRC papers before they are presented to the Sustaining Members. Fuels and Lubricants Coordinating Groups make arrangements for supplies of the materials necessary for use in research investigations of the various Groups. Whenever desirable, the materials are furnished with coded designations.

Improved Combustion Held Aid to

THE automobile industry recognizes its share in the solution of the urban air pollution problem. We believe that over the years the industry has made substantial progress in minimizing pollution from the internal combustion engine and that our current products generally represent the best we know how to make. Although we see no cause for alarm in the present situation, we believe that substantial further progress can be made as new information becomes available.

The industry is supporting a considerable program of research both through its contributions to such agencies as the Coordinating Research Council and the Southern California Air Pollution Foundation and in its own engineering and research laboratories.

We do not look for overnight miracles. But we have a strong faith that the long-range program now under way will ultimately lead to the development of principles which can be applied in production to give improved combustion in internal combustion engines. And that will reduce the quantity of undesirable contaminants discharged into the atmosphere. We look upon this job as a challenge to our ingenuity and as an opportunity to make further progress in the development of the internal combustion engine as one of the most useful servants of mankind.

1. Polluted Air A Product of Combustion

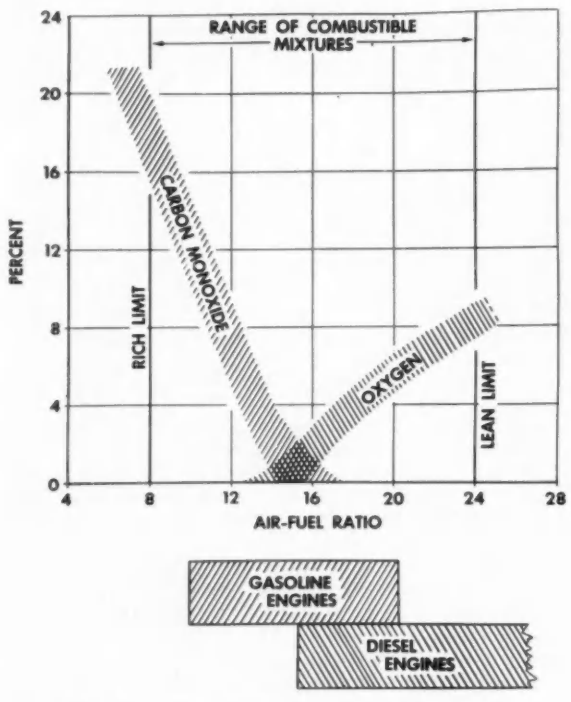


Fig. 1—Relation of exhaust gas composition to air-fuel ratio

The principal sources of atmospheric pollution are derived from combustion in some form or other. So the control of pollution involves control of combustion at the individual sources. We can do this either by eliminating the source, by separating the pollutants at the source, or by improving the combustion process itself so that the quantity of pollutants is reduced.

In the case of the automobile, the key to reduced air pollution is to improve combustion efficiency and thereby to reduce the quantity of undesirable pollutants discharged into the atmosphere.

The objectionable constituents of automotive exhaust gases vary according to the type of engine and a large number of operational circumstances. Carbon monoxide is probably potentially the principal offender from the gasoline engine and it may be present in exhaust gases in amounts up to 10 to 12% by volume. The remaining objectionable constituents such as hydrocarbons, oxides of nitrogen, oxides of sulfur, partially oxidized hydrocarbons. All those components that constitute smoke and odor are generally present in less than 1% by volume.

Correction of the objectionable features of a given exhaust gas requires analysis of the specific situation and application of measures directed at the underlying cause in each instance.

Unlike gasoline engines, diesel engines seldom discharge significant amounts of carbon monoxide. The general relationship between gasoline and diesel exhaust composition is shown in Fig. 1. The principal offense of the diesel engine is objectionable

Air Pollution Abatement

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Excerpts from paper "What Are We Doing about Combustion?" presented at SAE National West Coast Meeting, Los Angeles, Aug. 17, 1954.

smoke and odor. Gasoline-powered engines also sometimes emit objectionable smoke and odor. But in these cases the mechanism of smoke formation usually differs from that of the diesel and different corrective steps are required to relieve the problem.

All of these, carbon monoxide, smoke and odor, however, represent inefficient combustion. As such they indicate a waste of fuel as well as the nuisance that is created by them.

In the days of the kerosene lamp, if the lamp chimney was smoking we simply turned down the wick. In the case of the internal combustion engine, it is not quite that simple. But I believe that engineering studies will indicate where certain adjustments can be made in each particular instance that will improve upon overall combustion efficiency. This belief is based on progress that has already been made over the past years and the conviction that continued progress in this direction can be made provided there is sufficient incentive to do so.

2. Surveys Show Exhaust Gas Isn't Poisonous

The exposure to carbon monoxide in city streets has been found to be below the level for symptoms of acute poisoning. But the question is frequently asked whether persons exposed daily to lower concentrations will not acquire some ill effects over a prolonged period of time.

Probably the most thorough investigation of this subject was a study made by the U. S. Public Health Service on a group of traffic officers on duty in the Holland Tunnel in New York. This investigation covered a group of 156 subjects who had a daily exposure in the tunnel to concentrations of carbon monoxide at an average concentration of 70 parts per million (ppm) for a period of 13 years. At the same time, of course, these men were exposed to all the other components of exhaust gas including oxides of nitrogen, oxides of sulfur, aldehydes, fuel and oil vapors.

There was no evidence of injury to the health of these men. To the best of our knowledge today, there is no evidence of such a thing as chronic carbon monoxide poisoning.

Since the subjects of the Holland Tunnel investigation were at the same time exposed to all the remaining constituents of exhaust gas such as oxides of nitrogen, lead, sulfur, aldehydes, fuel and oil vapors, it is of further significance to recall these observations in view of recent concern with respect to the cumulative effect of such substances on respiratory diseases and lung cancer.

For example recently Dr. Paul Kotin working in the School of Medicine, University of Southern California, has made certain observations that in his opinion associate lung cancer with exhaust gas. Dr. Kotin and his associates have identified carcinogenic hydrocarbons in Los Angeles smog and he has identified these same materials (pyrene, benzpyrene, and anthanthrene) in the exhaust gases of both gasoline and diesel engines.

The production of these carcinogenic hydrocarbons seems to occur under operating conditions conducive to soot formation. Whether these compounds are present in the atmosphere in sufficient quantities to influence the incidence of lung cancer in the population is a subject that will require further investigation.

It is significant that the engine operating conditions Dr. Kotin has found to be conducive to the release of carcinogenic hydrocarbons are those of comparatively inefficient operation where soot is present. Soot is seldom present in significant amounts in exhaust gas from gasoline engines.

Please turn page

3. Exhaust Gas Concentrations in Los Angeles Smog Below Tolerance Threshold

The most authentic published information on carbon monoxide in the city of Los Angeles is found in the Report of the Air Pollution Control District. This report gives a maximum value of 23 parts of carbon monoxide per million of air in downtown Los Angeles during periods of intense smog. On clear days the value reported was 3.5 parts per million. Both of these values are considerably below values reported many years ago for other cities and more recently in Detroit. These figures indicate that contamination from exhaust gases in Los Angeles may not be as great as in other cities, such as New York or Detroit, for example.

Since these values for carbon monoxide reported for Los Angeles appear so low in the light of the charges being made against the automobile as a source of air pollution, the automotive industry is obtaining further information on carbon monoxide concentration in city atmospheres.

Based on this present information reported by the Air Pollution Control District, it is estimated that the dilution of exhaust gas at the street level in downtown Los Angeles—even during intense smog—is about one part exhaust gas to 2000 of air. This is about 12 times more dilute than the atmosphere used by the Bureau of Mines in which no ill effects due either to lead or exhaust gas were observed on animals over an eight-month period.

With respect to lead in the atmosphere of Los Angeles, the Air Pollution Control District has reported values ranging from two micrograms per cubic meter on clear days to 42 micrograms on smoggy days. These values are far below the maximum of approximately 150 micrograms for human tolerance and also are well below the values of 140 micrograms used by the Bureau of Mines in its investigation of the effect of gasolines containing tetraethyllead.

Values ranging between 0.7 and 10.4 with an average of 2.8, micrograms per cubic meter have been reported at the street level in downtown Detroit during heavy traffic. These values are also far below the accepted values for human tolerance.

With respect to oxides of nitrogen, the Air Pollution Control District has reported values ranging from 0.08 parts per million on clear days to 0.4 ppm on smoggy days in downtown Los Angeles. The maximum acceptable for human exposure over an eight-hour period is 25 ppm. So here again we are far below the range of harmful effects on human beings.

It is concluded, therefore, that although automotive exhaust gases may be a contributing factor to the overall air pollution problem in Los Angeles and other cities as well, we do not appear to be in any immediate danger from this source. Of all the potentially objectionable exhaust components, carbon monoxide is present in largest amounts and steps should be taken to bring about a reduction of carbon monoxide in exhaust gases as soon as practical means of doing so can be developed.

4. Ozone-Producing Hydrocarbons May Be Real Exhaust Gas Culprits

Recent investigations by Haagen-Smit and associates at California Institute of Technology have indicated the possible importance of hydrocarbons and oxides of nitrogen in connection with the Los Angeles smog problem. These substances seem to play a part in the formation of ozone which is peculiar to the Los Angeles problem and in the development of substances which cause eye irritation, reduced visibility, and plant damage. Certain leafy plants, namely, spinach, sugar beet, endive, alfalfa and oats are particularly susceptible. They show a characteristic spotting on the underside of the leaf which has been termed silver leaf.

It has long been recognized that exhaust gases contained small amounts of hydrocarbon. But it has not been until these investigations placed new emphasis on their possible significance in relation to air pollution that much attention has been given to them. Indeed, it was not until the development of the mass spectrograph in recent years that there was a practical means of identifying them in exhaust gases.

Investigations carried out at Stanford Research Institute have shown that over the range of driving conditions found in city traffic, there is a loss of hydrocarbon through the exhaust ranging from 5% of the weight of the fuel entering the carburetor under steady driving conditions to as much as 19% during periods of deceleration. It was estimated by these authors that the total daily emission of hydrocarbons into the atmosphere from automobiles in Los Angeles County was in the order of 850 tons.

Paine and Sigworth have called attention to the noxious qualities of blowby gases. They note that except under decelerating conditions, the exhaust gases contain a lower proportion of objectionable constituents such as hydrocarbons, aldehydes, acids, alcohols and organic hydroperoxides. In both blowby and exhaust gases, the noxious substances, excluding carbon monoxide, were found to be present in amounts less than 1%.

Hydrocarbon concentrations ranging from 0.2 part per million on clear days to 1.1 ppm on smoggy days have been reported in downtown Los Angeles. Such concentrations of hydrocarbon are easily accounted for on the basis of gasoline consumed in the area

and a dilution ratio of 1 part of exhaust gas to 2000 of air at street level, as previously indicated from carbon monoxide values found in Los Angeles.

The exact role of hydrocarbons and exhaust gas in causing eye irritation, plant damage, and ozone formation is a subject requiring considerable further investigation. For example, in regard to eye irritation, studies made at Stanford Research Institute have shown that removal of hydrocarbon from a synthetic smog mixture did not eliminate the eye irritating effect, although the presence of hydrocarbon and ozone produced more nearly the odor of natural smog.

Similarly, in regard to exhaust gas, all published efforts to produce plant damage with realistic concentrations of exhaust gas as found in city atmospheres have required the introduction of artificially-produced ozone at the same time. Ozone alone, which is found in amounts up to 0.3 ppm in Los Angeles smog, will cause plant damage. But generally the type of damage so produced differs from natural smog damage.

Exhaust gas alone does not produce plant damage except in concentrations much higher than those found in the atmosphere. As yet, I am not aware of plant damage having been observed where plants were exposed to realistic concentrations of exhaust gas in sunlight and without the use of artificially-produced ozone.

Ozone appears to play an important part in the problem. Oxides of nitrogen, which are a natural product of combustion reactions, may play a secondary role together with hydrocarbons in the presence of sunlight to produce ozone as indicated by Haagen-Smit's work. If such is the case, elimination of either hydrocarbon or nitric oxide would break the chain of ozone formation and plant damage and eye irritation would be eliminated by prevention of ozone formation.

As previously indicated, the steps in this reaction are of extreme technical importance and require a great deal of further study to be fully understood. We are pleased to note that investigations along these lines proceeding in several different laboratories throughout the country. The Southern California Air Pollution Foundation has been formed to insure intensive investigation of the problem on all sides.

5. Progress in Engine Efficiency Helps Curb Exhaust Gas Emission

It is fortunate that the natural engineering and competitive incentives at work in the automotive industry are in harmony with the factors which tend to reduce atmospheric pollution from exhaust gases.

For example, in a representative group of cars representing all price classes, carbon monoxide has been reduced to approximately one-half of what it was in 1927. This trend is shown in Fig. 2.

Further, the trend of the industry has been toward higher compression ratios in the effort to gain in fuel economy. This trend has been particularly significant since World War II when average compression ratios have increased from 6.5:1 in 1946 to 7.7:1 in 1954.

As a result of these developments, (use of leaner mixtures and higher compression ratios, coupled with other engineering developments and corresponding improvments in fuels), gasoline consumption has been reduced by approximately one-third with respect to the amount that would have been required in the engines of 1927 to do the same transportation job that we are doing today.

We believe that this is very significant progress. It not only means that we have brought about a 50% reduction in carbon monoxide content; but by reducing the total consumption of gasoline, we have reduced by about one-third the amount of total exhaust gas with respect to the amount that would have been produced if this engineering progress had not taken place.

This is an example of what we mean by evolutionary progress made through intelligent engineering changes made at the factory. We believe that these trends will continue.

Please turn page

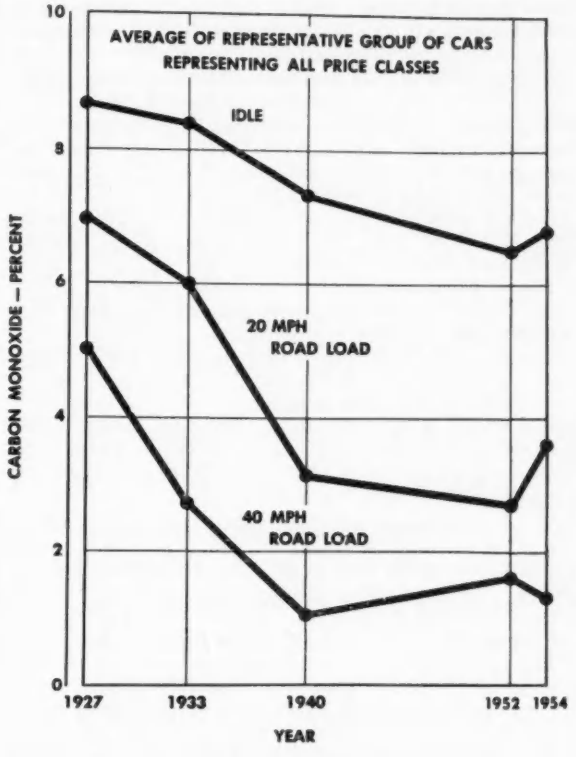

Fig. 2—This chart depicts the progress in the reduction of carbon monoxide emitted by passenger cars between 1927 and 1954

6. Exhaust-Treating Gadgets Just Aren't Practical

The attention that has been directed toward exhaust gas as an air pollutant has stimulated the ingenuity of a great many inventors to develop exhaust treating devices. Most of these devices involve some form of filter or combustor either catalytic or non-catalytic as an accessory device to accomplish this objective. Often the inventors are not cognizant of the many problems involved in the practical operation of such devices.

To be commercially practicable, such a device must operate without attention over a long period of time. It must be capable of functioning over a wide range of gas flow rates and compositions as found in the automobile exhaust. Catalytic devices must be unaffected by compounds of lead, sulfur, phosphorous, and other elements normally present in gasoline and lubricating oil.

At the present time, we do not know of any device, regardless of price, that meets all of these specifications. If we find such a device, we foresee an extremely costly installational problem and the additional expense of installation and maintenance would have to be borne by the car owner. Finally, there is the problem of periodic inspection to make sure that the device continues to work properly. Only a few states, not including California, now have vehicle inspection systems that could even begin to perform this function.

7. Automotive Industry Launches Intensive Program

In recognition of the intensified interest in air pollution that, is taking place in various cities of the country, the Automobile Manufactures Association has formed a committee known as the Vehicle Combustion Products Subcommittee of its top Engineering Advisory Committee. The Vehicle Combustion Products Subcommittee is charged with the responsibility of making studies of problems relating to atmospheric pollution caused by exhaust gases and making recommendations for constructive action to be sponsored by the Automobile Manufacturers Association and through the Association to be translated into action by the member companies.

This Subcommittee was formed in December, 1953. One of its first acts was to visit in February, 1954, with officials of the Los Angeles County Board of Supervisors and Los Angeles County Air Pollution Control District for the purpose of studying at first hand all available information bearing on the air pollution problem in Los Angeles. At the same time, the Subcommittee had the benefit of discussions with other interested groups.

These discussions proved to be very helpful to the Subcommittee in becoming acquainted with the many aspects of the problem.

Thus far this Subcommittee has made several recommendations to the Automobile Manufacturers Association. All of these recommendations have been accepted and are now being carried out.

These recommendations are as follows:

1. Initiation of a survey of exhaust composition of motor vehicles. This survey is to be conducted under the auspices of the Coordinating Research Council and will include development of procedures for sampling and analyzing exhaust gases, determination of the effect of engine, fuel and lubricant variables on exhaust gas composition, and finally a statistical sampling of exhaust gas composition from cars in service.
2. Cooperation with local dealer groups in development of a campaign to reduce visible emissions from motor vehicles presently on the road through owner maintenance and repair.
3. Attention of the industry has been called to the substantial loss of unburned fuel through exhaust gases. The object is to develop design changes which will reduce these losses and thereby reduce atmospheric pollution and improve fuel economy throughout the country.
4. Continued cooperation with technical groups in the development of facts relating to atmospheric pollution from automotive equipment, and to render assistance in evaluation of devices applicable to internal combustion engines which offer some prospect of reducing atmospheric pollution.

As further evidence of the automobile industry's interest in this whole subject, the Automobile Manufacturers Association has made a grant of $50,000 to the Southern California Air Pollution Foundation. Upon invitation from the Foundation, Mr. C. F. Kettering has been elected to represent the automobile industry on its board of trustees. Supplementing these joint research programs, the individual automobile companies are, of course, conducting their own investigations relating to this general subject.

(Paper on which this abridgment is based is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

FLASH!

The latest developments on alleviating air pollution by motor vehicles will be discussed at the Air Pollution Symposium, at the SAE Golden Anniversary Annual Meeting, Detroit, January 10, at 8:00 p.m., in the Grand Ballroom of the Sheraton-Cadillac Hotel.

Boston Conclave Bares Current Thinking On Transportation Problems

RECIPE FOR A SUCCESSFUL TRANSPORTATION MEETING: Pour lots of fresh ideas into the hopper, stir well into a batter of more than 300 fleet men and truck engineers, spice it with such things as an antique car and sports car and engineering display, and let it simmer for three days in an atmosphere of Bostonian conviviality.

These are just the ingredients that went into the SAE National Transportation Meeting in Boston, Oct. 18–20. Those who sampled the resulting dish found it satisfying as food for present and future thought. Their reactions to the technical ideas fed them reveal that Boston-inspired discussion will continue for a long time to come.

Discussion of electronic scales for weighing vehicles brought varied reactions. Some said that such a fast, fairly accurate weighing technique used in law enforcement would make it less attractive to less scrupulous operators to overload, remove the temptation to overload. This won't work against the operator. If his competition is confronted with the same real weight limitation, no one will have an unfair advantage.

Others still are leery of electronic scales. They're too inaccurate, said one man. "If you had been fined for being 10 lb above a 40,000-lb limit as we have, you wouldn't care to take the risk of depending on a scale that may be accurate to perhaps within only 5%."

Description of Greyhound's new Scenicruiser bus led one engineer to muse "it's about time." He felt this was the first vehicle that makes available the true advantages of bus travel.

He reasoned that bus travel inherently can offer the traveler more convenient terminals and more frequent headways between smaller towns than either the airlines or the railroads. The bus also travels through more scenic country. The bus passenger can now more fully appreciate the scenery with the Scenicruiser's picture windows and observation platform. A rest room aboard also adds to passenger comfort.

Outdoor storage discussions generated reactions, varied and conflicting. Adherents of garages met head-on with outdoor storage advocates. But when the smoke cleared, both sides found they weren't as far apart as they first seemed to be.

It all boiled down to the least expensive way of doing each specific job. Bakery operators, for instance, have to keep their baked goods warm. That additional requirement often makes garages feasible. But a common carrier in the temperate zone said he could get by with outdoor storage and unit heaters. And there were lots of variations in between discussed at the Meeting . . . with shed type and carport type structures serving the purpose in some cases.

The same kind of thinking prevailed in evaluation of the nickel cadmium battery. Sure it's more expensive initially, said one fleet operator. But if it can do for me what the lead battery can't do, it's worth it. In very low or very high temperature applications or where high amperes are needed for short periods, the nickel-cadmium battery was said to be a real boon.

Fleet men agreed that an even more lucrative area for saving a dollar, or making one, is in proper load distribution. A truck man advocated placing the fifth wheel kingpin as far forward of the tractor rear axle as possible. That helps transfer the trailer load to the tractor front axle.

One fleet operator agreed with the philosophy, but bemoaned his fate for practicing it. He said he was being called on the carpet by ICC for operating unsafe tractor semitrailers, because the kingpins were set some 24 in. ahead of the tractor rear axle. Most agreed that the ICC charges are technically unsound. Greater kingpin offset makes a vehicle *safer*, and for three reasons: (1) it increases skid resistance, (2) it furnishes greater overturning resistance, and (3) adding weight to the tractor front wheels enhances steering control.

On the following pages are highlights of each paper presented at the meeting.

They Planned the Meeting

R. C. Wallace (left), SAE Vice President for Truck & Bus Activity; Robert Gardner (center), general chairman of the Meeting; and H. L. Willett, Jr., SAE Vice President for Transportation and Maintenance Activity

Highlights from the Papers

Garages or Not

Our two-tone paint jobs, including decals, average about $125. Normally the trucks are repainted every second year, with one touch-up job in between. Currently our paint cost, including lettering and/or decals runs approximately 1/4¢ per mile operated . . .

. . . **R. W. Thomas, Quality Bakers of America Cooperative, Inc.,** "Bakers Like Enclosed Storage."

Conservative cost estimates made by our company committee showed that construction of garage facilities would involve an average investment of $5000 for each truck. That would amount to an annual charge of $750 for each unit, considering depreciation, taxes, interest on investment, maintenance, and other miscellaneous charges . . .

. . . **J. M. McGinnis, Shell Oil Co.,** "Are Storage Garages Economically Justified?"

The vehicle storage solution is not in building modern garages because most of us can't afford it. But it is possible to provide good storage at a much reduced cost by erecting a shed-type structure or adapting one of the metal prefabricated buildings currently available. . .

. . . **R. M. Knutsen, Cleveland Transit System,** "Relative Merits and Economies of Inside and Outside Storage of Transit Vehicles."

Load Distribution

Perfect geometrical load distribution is difficult to achieve. There are physical limitations on the amount of kingpin offset, the amount of kingpin overhang on the semitrailer, and the location of the semitrailer axle or tandem center.

In many operations it is necessary to interchange semitrailers which may differ considerably in kingpin or axle tandem overhang. Standard semitrailers are not usually proportioned ideally.

Legal restrictions often dictate axle or tandem location irrespective of effects upon load distribution . . .

. . . **Merril C. Horine, Research Division, Mack Mfg. Corp.,** "More Payload Through Better Weight Distribution."

Truck Development

From our proving ground tests we learned two important lessons: (1) destructive torques can be introduced into the drive system by imperfect shifting of the transmission, and (2) the time on the 9% grade and the gross load determine the life of axle gears.

continued on page 62

The Challenge Ahead

The next 50 years holds even greater progress for trucks than was achieved in the last 50, opined dinner speaker Robert F. Black, president of The White Motor Co. That's because of the challenges ahead, said Black, and the many technological advances now at the threshhold of realization.

A host of demands face the commercial vehicle engineer . . . lighter weight, more power on grades, conflicting state law requirements, lower vehicle costs, greater fuel economy, improved accessibility, more built-in safety, and more driver comfort.

Around the technological corner, said Black, are developments which will achieve some of these goals in the not too distant future. Simple automatic transmissions and gas turbine engines are among the new ones in the offing.

So much of the industry's future is in the hands of the engineer, concluded Black. Ahead of him lie new fields to conquer, engineering adventure and challenge.

On Monday night, October 18, the Cities Service Band of America radio program extended a salute to SAE and National Transportation Meeting in Boston. That same night the Cities Service Quartet, above, entertained at the Meeting.

They Spoke at the Banquet

(Left to right), SAE President William Littlewood; Dinner Speaker Robert F. Black, president, White Motor Co.; Toastmaster Rudolph J. King; and SAE New England Section Chairman Gustav Heiber

Around the Meeting . . .

Toastmaster **Rudolph King** told of the old lady who had spent her life on a farm and was sent to a rest home. Each week her farmer nephew faithfully visited her and always brought her a quart of fresh milk from his farm. The lady's doctor advised the nephew to slip a little brandy into the milk as a health measure. This the nephew did. On one of the visits, the little lady drew her nephew aside and said: "John, don't ever sell that cow!"

* * * * *

Unheralded but constructive . . . that's one way of describing the performance of the secretaries at the technical sessions. The men who handled the session reporting assignments at the Meeting were: **A. W. Devine, G. T. Brown, M. K. Simkins, Henry Jennings,** and **J. R. Comeau.** An extra cheer is in order for Murray Simkins who reported two sessions, pinch-hitting at one.

* * * * *

Credit for the success of the Truck and Bus Engineering Display goes to **Gustav Heiber** and his Promotions Committee. The displays of the 32 exhibitors proved to be a highlight of the Meeting. This was just one of the ways in which Heiber, Chairman of the SAE New England Section, helped spark the Meeting.

* * * * *

Well-run technical sessions were a tribute to the men who chairmanned them. They were: **R. F. Lybeck, J. H. Hickman, B. F. Jones, E. P. Gohn, D. A. Fales,** and **J. A. Hassey.**

* * * * *

Bouquets to **Frank Johnson** for the crowd-pleasing sports car and antique car display he arranged in Boston's Copley Square. He received the cooperation of the Veteran Motor Car Club of America and car manufacturers. Cars shown included the following:

American Sports Cars

- Chevrolet Corvette
- Ford Thunderbird
- Hudson Italia
- Dodge Firearrow
- Nash-Healy
- Kaiser Darrin

Foreign Sports Cars

- Porsche
- Triumph
- Jaguar
- Austin-Healy
- M. G.
- Doretti
- Volkswagen
- Alpine Sunbeam Talbot

Antique Cars

1907 Autocar	1906 Ford Model K	1909 Renault
1912 Buick	1910 Franklin	1927 Rolls Royce
1911 Chase	1909 Hudson	1912 Stanley Steamer
1914 Chevrolet	1921 Mercer	1910 Stevens Duryea
1929 Dusenberg	1928 Mercedes	1909 White

SAE President William Littlewood was among the crowd which inspected the antique cars and modern sports models on display.

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The first-mentioned lesson points to the design problem of providing a drive system that will cushion shock loads. The second lesson emphasizes the fact that the operator must define what he means by "satisfactory" with regard to component life. Then he must honestly face the fact that he cannot get more component life by doing more work . . .

. . . **Paul T. Brantingham, Motor Truck Division, International Harvester Co.,** "A New Engineering Facility for the Design and Development of Improved Motor Truck Transportation."

Vehicle Weighing

Here is what a study on the Shirley Highway (near Washington, D. C.) showed, where a high percentage of the trucks operate at or near the legal limit: By using an electronic scale in connection with enforcement of weight regulations, over 60% of the vehicles now being stopped to be weighed statistically would not need to be stopped.

This percentage will of course increase as the accuracy of the electronic scale is improved. . .

. . . **O. K. Normann, U. S. Bureau of Public Roads,** "Weighing Vehicles Static and in Motion by Electronic Scales."

New Bus Concept

We have a new operating concept, which is part of the plan for using the Scenicruiser. It's the use of spare engines instead of spare coaches, strategically spaced to take care of ordinary maintenance as well as emergencies.

It is possible to change either of the two engines in this new bus in minutes. Special disconnect fittings and a special dolly make possible removal of the engines and all accessories without even draining the radiators . . .

. . . **Joseph M. Sills, The Greyhound Co.,** "The Two Level Intercity Coach."

Nickel-Cadmium Battery

In accelerated life tests consisting of 3000 cycles (equivalent to 10 years of hard usage), the nickel-cadmium battery showed no loss in capacity.

This sintered plate battery will start an engine at -65 F. It will also operate successfully at very high temperatures. at least up to 165 F.

And the battery is not harmed in any way by years of storage. Stored at room temperature for one year, the battery will retain more than 60% of its full charge . . .

. . . **L. Grant Hector, Sonotone Corp.,** "What the Nickel Cadmium Battery Can Do for Fleet Operators."

2-Stroke Diesel Reappraised At Cleveland Meeting

ENGINEERS crowded the technical sessions of the SAE National Diesel-Engine Meeting, held in Cleveland, October 26–28. They were not disappointed, for they were able to come away with new data on 2-stroke diesels and on cold-starting problems.

More specifically, they learned how:

- Phenomenal increases in the output of 2-stroke diesels are being obtained experimentally by the addition of turbosupercharging.
- Useful, if more modest, improvements in output can be obtained by design changes aimed at better scavenging flow of 2-stroke diesels.
- Cold starts at ever lower temperatures—approaching a – 65 F goal—are being attained by such aids as:
  - New arctic engine oil.
  - Specially formulated starting fluids.
  - Starters operated at higher voltages.

Turbosupercharging 2-Stroke Diesels

The Navy, as a big user of 2-stroke diesel engines, is particularly interested in seeing that the turbosupercharging studies are fruitful, according to Rear-Admiral W. D. Leggett, Jr., chief, Bureau of Ships. At the Dinner, where he was principal speaker, he reported that a Naval engineering study indicated "we should be able practically to double the output of the 2-stroke diesel, possibly reduce fuel consumption—and the engine would, in all probability, like the treatment."

"Almost doubling the output of one of our 2-stroke engines through turbosupercharging," he continued, "is so close to the dream of getting something for nothing that we are still a little suspicious. We have gone far enough, however, to know that it isn't all dream, but it is too early to say just how much we can gain and what the cost will be."

Corroboration plus further details on this work were brought out by two papers presented at one of the technical sessions. Both tell how 2-stroke diesels were made to give tremendously increased output in the laboratory by means of simulated turbosupercharging.

A GM model 1-71 diesel engine gave up to 200 psi bmep at 1800 rpm. Turbosupercharger effects were simulated by providing an external source of air at controllable pressures and temperatures for the scavenge air supply. The engine was operated against various back pressures. Modification of the combustion chamber allowed tests to be run at compression ratios of 6, 8, and 10 to 1. Normal is 16 to 1.

The output of the GM 16-278A diesel—an engine widely used by the Navy—was raised from 1600 bhp to 3000 bhp at 750 rpm, with the aid of an exhaust-driven turbosupercharger, engine-driven Roots blower, and aftercooler. Thermal efficiency from 1500 to 3000 bhp was actually better than that at the original 1600 rating.

Better Scavenging Flow

Another way of attaining some increase in output from the 2-stroke engine is to improve scavenge flow. The possible increase is not nearly as spectacular as that obtainable with turbosupercharging, but it is still worth while. Investigations are proceding by means of a 5-orifice pitot sphere, which is used to probe the flow conditions inside the cylinder of the uniflow-scavenged engine. It appears that the ideal scavenging process of a moving "piston" of fresh air driving out before it a column of exhaust gas is far from being realized. Actually, the flow seems to be more in the nature of a vortex, with the center of rotation slightly off the cylinder axis.

Better Cold Starting

The diesel is inherently harder to start than the gasoline engine because there is no spark to start the burning going. Thus, the diesel needs real help

Dinner Speaker

Rear-Admiral W. D. Leggett, Jr. (center), main speaker at the Dinner, tells C. A. Bierlein (left), chairman of the Cleveland Section, and Toastmaster A. T. Colwell (right) that nuclear power and gas turbines aren't going to displace the diesel for a good long time to come

to attain the – 65 F cold starts desired by the military for arctic operation.

Cooperative development by the Army and industry of a new arctic engine oil—MIL-O-10295(ORD)—has been one approach to the problem. This low-viscosity oil has a pour point of – 65 F, with acceptable engine wear characteristics and oil consumption at elevated temperatures.

Fluid aids are also helpful but, it was emphasized, technique in using them is most important. Poor technique, even with good fluid, can lead to failure.

Cold starts can be attained at lower temperatures by the use of a starting system of, say, 24–30 v in place of the 12–24 v used at higher temperatures.

(Given below is an excerpt from each of the papers presented at the technical sessions of the meeting. These papers will be treated in more detail in later issues of the *SAE Journal*. Complete copies of each paper are available in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Meeting Planners

Three men who helped to plan the meeting look pleased because of its success. They are (left to right): John Dickson, vice-president for the Diesel-Engine Activity, H. W. Barth, general chairman of the meeting, and Martin Berlyn, meetings vice-chairman of the Diesel-Engine Activity Committee

High-Bmep European Diesels

There are diesel engines commercially available in Europe with bmep's far exceeding any in this country.

The 2-stroke-cycle Napier Nomad, for example, by using its exhaust energy both to drive a turbocharger and to provide added crankshaft power, has an output of 287 psi bmep with a supercharging pressure of 75 psig. In comparison, our most comparable American diesels have outputs not exceeding 90 psi bmep. . .

. . . **Warren G. Payne and Wolfgang S. Lang, U. S. Naval Engineering Experiment Station,** "High-Supercharging Development of GM 16-278A 2-Stroke-Cycle Diesel Engine."

Cold-Starting Aids

The relative effectiveness of various starting aids and cranking systems is not constant. The best aid for each application can only be determined by trial and error.

The starting performance of most engines may also be improved by adopting 24-30-v cranking systems in lieu of 12-24-v systems. No system tested was fully satisfactory, since those giving the highest cranking speeds and were easiest to charge at low temperatures provided only a short period of cranking before exhausting the system. In brief, there are still many problems to be solved before all diesels can be satisfactorily started at subzero temperatures. . .

. . . **James F. Blose, J. P. Qualey. J. T. Duck, and L. G. Schneider, U. S. Naval Engineering Experiment Station,** "Effeet of Low Ambient Temperature on Cranking and Starting of Diesel Engines."

Many members of the audience came forward to inspect the cold-weather clothing and starting aids exhibited at the meeting by the Engineer Research and Development Laboratory, Fort Belvoir

Arctic Operations

The ability to function in any area of the world—including the arctic and subarctic—is a primary military objective. All signs point to the maintenance of ground support bases at these areas, even where subzero temperatures prevail.

Business interests have likewise become active in pressing the search for new sources of important raw materials and power in the comparable fringe areas, that is, Canada.

Therefore, the Army and industry now appear to share a definite interest in such arctic regions . . .

. . . **P. W. Espenschade, Engineer Research & Development Laboratories, Ft. Belvoir,** "Low-Temperature Engine Testing and Facilities."

Left to right: Past SAE Vice President R. W. Seniff of the B&O, F. A. Robbins of Koppers, and H. W. Barth of Cleveland Diesel look over one of the old cars at the Thompson Products Auto Album and Aviation Museum, which was open for inspection by those attending the meeting. Tours were also made of the following plants: GM Cleveland Diesel-Engine Division, GM Euclid Division, NYC RR Collinwood Shops, and Perfection Stove Co. cold-test laboratories

Cold-Starting Problems of Military

The winter of 1946–1947 was the first in which a fully mechanized Army tried to live in the field without benefit of normal arctic station accommodations. For 14 days the temperature never rose above – 55 F. By the time troops had become established in their field accommodations they found that their mechanized units were practically immobile.

One of the reasans lubricants became solid was that the sudden drop in temperature had prevented the application of the prescribed diluting procedures. It simply got too cold too fast to prepare all the equipment properly.

. . . **W. E. Meyer and J. J. DeCarolis,**

At the predinner reception, SAE President William Littlewood (center) listens to SAE past-presidents R. J. S. Piggott (left) and Ralph Teetor (right) reminisce about the "good old times" when they each were president. Piggott served in 1948 and Teetor was president in 1936

Around the Meeting . . .

Definition of a diesel engine—Harry Horning's definition, as related by **Arch Colwell:** It's an engine with the head off and a lot of engineers standing around wondering. Definition of a diesel engineer, by **Martin Berlyn:** An engineer who has been on the diesel cycle until he has made the rounds of all the companies.

★ ★ ★ ★ ★

It was whispered around the meeting that cheap residual fuels have become a hot subject that may be ready for technical-paper or Summer Meeting round-table treatment one of these days—when engineers learn enough about it to talk. The trouble seems to be that manufacturers still don't know much about the performance of these fuels in their engines. So far, all the work done has been by their customers. Meanwhile, it was said, the gas turbine people are running into unexpected difficulties with these fuels. **Admiral Leggett** said at the Dinner that the Navy would like to burn residuals in their diesels. Need for one less fuel would simplify the logistic problem.

★ ★ ★ ★ ★

Credit for the smooth handling of the technical sessions goes to the following, who served as chairmen: **W. F. Burrows** of White, **Fred Robbins** of Koppers, and **W. I. Hamilton** of Lanova.

★ ★ ★ ★ ★

H. W. Barth, general chairman of the meeting, told this one at the Dinner. It seems a large aircraft manufacturer had a plane with wings that fell off everytime the pilot tried to take it through the sonic barrier. Each time he had to parachute to safety. No matter what changes the engineers made, they couldn't seem to get anywhere on the problem. One day the janitor suggested, "Why don't you put ¼-in. holes 1 in. apart along the joint?" Not being able to think of anything better, the engineers tried it. This time the plane flew through the barrier without difficulty.

As a result, the chief engineer told the janitor he could have any job he wanted and asked him how he knew his idea would work. "I've worked in wash rooms for 30 years," he replied, "and I've yet to see toilet paper tear at the perforations."

★ ★ ★ ★ ★

The rather thankless task of being secretary at the technical sessions was ably filled by each of the following: **C. G. Goohs** and **R. A. Pejeau,** both of Cleveland Diesel, and **J. J. Broderick** of GE.

★ ★ ★ ★ ★

Arch Colwell, toastmaster at the Dinner, told a story he said was often related by Ralph Teetor, Perfect Circle, about Mr. Cummins. Mr. Cummins, it seems, had an engine he claimed would run on anything. One day, when he was taking some freinds for a ride in his boat, the engine ran out of gas. He calmly filled a can with water from the Ohio River and dumped it in the fuel tank. He then drove the party back to the dock. (Secret: There was still about 2½ in. of fuel in the bottom of the standpipe. When the water was added, it simply pushed this fuel into the engine.)

★ ★ ★ ★ ★

The tall gentleman with the big smile, who welcomed one and all to the meeting, was **F. X. Sieloff,** chairman of the Cleveland Section Reception Committee.

★ ★ ★ ★ ★

In commenting on the membership drive that brought SAE membership near the 20,000 mark, President Littlewood told Dinner guests that emphasis had been on quality. There was no drive for numbers, as such. In particular, every effort was made to get more executives and also more young engineers to sign up.

★ ★ ★ ★ ★

The SAE Diesel-Engine Activity Committee, which met during the week, completed plans for the diesel sessions at the 1955 Golden Anniversary Meeting in Detroit. Papers will cover future possibilities of the diesel, a new fuel injection system, and air pollution.

Pennsylvania State University and R. L. Stanley, Diesel-Engine Manufacturers Association, "Engine Cranking at Arctic Temperatures."

High-Output Engine for Navy

The immediate Naval application for a high-output, compact, fairly efficient, oil burning engine is for main propulsion in tracked landing vehicles and other landing craft. Such a powerplant is feasible with some development of parts for reliable operation. The 200-psi bmep goal was obtained with satisfactory operating temperatures, pressures, and fuel economy. . .

. . . **H. T. Smith, Tracked Vehicle Test and Experimental Unit, Marine Corps Base, Camp Pendleton,** "High-Supercharge, 2-Stroke Diesel Investigation."

Starting Fluids

Continued combustion studies of starting fluids and diesels fuels in engines at low cranking speeds and temperatures may provide information not only helpful in the development of superior starting fluids but also in better predicting the behavior of diesel fuels in engines at both low and high temperatures. . .

. . . **W. G. Ainsley and H. D. Young, Sinclair Research Laboratories,** "Application of Starting Fluids to Internal-Combustion Engines."

Better Scavenging

When the engine builder attempts to improve scavenging efficiency, whether by means of increasing the scavenging ratio or by changing port configuration, he must keep in view the entire engine design.

For example, if he were to select a new port angle, without changing any other variable, the result might be:

- A higher pressure drop and therefore a lower scavenging ratio.
- More heat loss during compression, due to the effect of swirl on heat transfer.
- Poor fuel and air mixing, resulting in increased smoke and fuel consumption. . .

. . . **W. H. Percival, GM Research Laboratories Division,** "Method of Scavenging Analysis for 2-Cycle Diesel Cylinders."

F & L Meeting Stresses Cooperation

COOPERATION between the oil and automotive industries and between these industries and the military services was never more strikingly demonstrated than at the National Fuels and Lubricants Meeting in Tulsa, November 4 and 5.

Dr. D. P. Barnard, Past President of SAE, and toastmaster at the dinner said that since World War II the oil and automotive industries have come closer together in basic objectives. Of course, the age-old problem—should autos be built to run on existent gasolines, or should gasolines be refined to accommodate current engines—is still to be solved.

Arranging for meeting . . .

The Committee on Arrangements preparing for the National Fuels and Lubricants Meeting. Seated at the table are (left to right) H. P. Enders, in charge of dinner ticket reservations, L. A. McReynolds, general chairman, J. V. Brazier, housing chairman. Standing (left to right) are D. W. Frison, publicity director, W. W. Schafer, in charge of the Social Hour, F. A. Suess, 1953 Fuels & Lubricants Activity Vice-President, W. F. Lowe, registration chairman, and T. L. Gordy, Chairman of the SAE Mid-Continent Section

Dinner guests get together

D. P. Barnard, toastmaster, Major General John F. Uncles, guest speaker, and William Littlewood, SAE President, get together during the Fellowship Hour before the Dinner. General Uncles spoke on "Research and Development In The Army"

But, with the help of technical organizations such as SAE and CRC, the two industries are cooperating more and more for their mutual benefit.

A fleet operator and oil engineer furnished a specific example of what could be accomplished by close inter-industry coordination. They reported the results of a joint experiment adding propylene to propane motor fuel in buses of a municipal transportation company.

Another instance of the two industries working together to improve their products is the new oil test engine which is being developed by CRC to replace the outmoded L-4 test engine. More about this new tool for evaluating lubricants will be reported in a later issue of the SAE Journal.

Speaking of lubricants, two NACA researchers reported on their investigation of lube oil characteristics at high temperatures. This "very important and forward looking" project emphasized that supersonic flight needs new lubricants that can withstand the 1000 F temperatures which occur in jet engines. Since liquid lubes break down and leave deposits, solid lubes may be the only solution. This research, which started in an aeronautical lab, may have far reaching effects in the oil industry. Eventually, it may change lubrication practices in the automotive field too.

Cooperation between industry and the Army was symbolically pointed up by the presence of Major General John F. Uncles, Chief of Research and Development for the Army. His address as guest speaker is reported on page 69. The General praised private industry for its continued shoulder-to-shoulder work with the Army. One example is the program for standardizing engines and accessories for military use.

But, inter-industry and industry-armed forces cooperation is only part of the story unfolded at Tulsa. The two day session showed how cooperation and understanding between the design and maintenance functions of companies and between the industry and educational institutions would reap great benefits.

The automotive industry can benefit from new research discoveries in educational institutions. Typical was the university-led research into the use of nitromethane as a piston engine fuel. This created much interest and discussion at the Meeting. Some hot-rod and road racers are using nitromethane to give added punch to regular fuel. The future may see more and more nitromethane used as an additive in passenger car fuels, some engineers surmised.

The Fuels and Lubricants Activity Committee meeting held in Tulsa recognized that much basic knowledge starts in university research projects. An attempt will be made to encourage more college participation in SAE activities.

William Littlewood, President of SAE and Vice-president, American Airlines, stressed the need for close harmony between design and maintenance activities in the industry. An example of this kind of cooperation was the research project which simplified a maintenance procedure of testing used lubricating oil in a railway diesel engine.

Also, a tractor company research engineer helped a maintenance problem by reporting how oil additives will reduce waste from too frequent oil changes and increase diesel engine life.

The following are highlights from the technical papers presented at the Meeting, which will be handled in more detail in subsequent issues of the Journal. Complete copies of each paper are available in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.

Gum Deposits

Gum deposits in carburetors disrupt the fuel air mixture and cause stalling, rough idling, and poor mileage. These deposits come from inlet air which is contaminated by blowby, and exhaust fumes during idling. They can be removed by using detergent action gasolines during normal operation. . .

. . . H. W. Sigworth and J. Q. Payne, California Research Corp., "The Cause and Correction of Carburetor Gumming."

Intake system gum deposits from six different gasolines were tested by chromotography. They were found to be chemically similar although the amount of deposit varied considerably. Deposit precursors appear to be non-hydrocarbon and contain some phenolic material. An alumina column test will quantitatively measure the depositing tendency of gasolines. . .

. . . C. R. Bauer, E. I. du Pont de Nemours and Company, Inc., "Detection and Isolation of Induction System Deposit Precursors From Gasoline."

Two new tests for determining the gum content of gasoline and induction system deposits correlate much more closely to actual operating results than the ASTM tests. In the Lauson test the deposits are dissolved in naptha and acetone, then the gums are recovered and weighed. This test predicts service characteristics of gasolines that don't contain additives.

The Induction System Deposit test is simpler. Gasoline is flash evaporated and the residue gums are leached with a hexane-heptane solvent, then dissolved in acetone. Then the acetone is evaporated and the gum weighed. The ISD test requires 4-to-5 hours against the 28 hours required for the Lauson test. . .

. . . C. Moore, J. L. Keller, W. L. Kent, and F. S. Liggett, Union Oil Company of California, "Evaluating Gasolines For Induction System Gums."

Piston Ring and Cylinder Wear

Although new engine designs represent great advancements and improvement, there is still much piston ring and cylinder wear.

Wear rates are subject to wide and unexplained variations. Wear data should be related to carefully selected reference data, preferably from the same test in the same engine.

Limited data seems to point in the direction of increasing oil consumption to reduce wear. . .

. . . A. M. Brenneke, and M. E. Estey, The Perfect Circle Corp., "Piston Ring and Cylinder Wear—An Appraisal of Current Problems."

1953 Car Octane Needs

235 new cars, representing nine different 1953 models, were tested for octane requirement with the following results: Five models that had significant design changes from 1952 models required increases from 2 to 6 octane numbers. Maximum octane requirement occurred

Army Seeking More Power, Better Storage Stability in Fuels

"HIGH **energy fuels and engines** that will give better fuel economy and performance, is the immediate goal of military research," said Major General John F. Uncles, Chief of Army Research and Development, at the dinner. Also, storing and transporting fuels and oils under extreme climate conditions still is a problem to be solved. "Freedom from current restrictions will mean a decided combat advantage, will simplify the logistics problems involved, and will save manpower," the General said.

To achieve this the Army looks to industry and to technical groups such as the SAE for help. "Only by a national pooling of research facilities can the United States hope to keep ahead of the enemy in new materials and weapons."

Sometimes the military can tell research and development groups just what it needs in the way of new weapons. For instance, the machine gun was improved so that now only one man is required for a crew where previously four men were needed. However, research must also originate ideas and place new concepts and materials before the military. This will aid strategic planning.

One consideration of strategic planning is mobility. In the age of atomic weapons, military forces must be kept dispersed. But they must be able to converge quickly on a point of attack.

So, **the Army is interested** in anything that allows a division to be easily and quickly moved. Air transports, helicopters and ground vehicles that can operate in extreme climates and terrain are a necessity.

Another very important strategic consideration is logistics. In World War II about 60% of all overseas cargoes were petroleum and petroleum by-products. If the Army can reduce fuel transportation and the size of its stock piles, more space can be given to putting weapons, medical supplies, and rations in the hands of the doughboy. Reducing petroleum volume and yet retaining Army mobility shows the need for new engines and fuels with added power. That's why aircraft, tanks, and other vehicles capable of operating beyond lines of fuel supply for long periods of time are so important.

"The Army is a forward looking organization," the General said in closing. Since its overall policy is to prevent war by increasing its ability to win if the enemy should start one, the "Army intends to have the finest equipment in the world."

Around the Meeting . . .

Dr. D. P. Barnard, toastmaster at the dinner introduced guest speaker, Major General John F. Uncles, as a "card-carrying" former member of the famous Battery D, 129th Field Artillery. This was the outfit captained by Harry S. Truman.

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While **Leo A. McReynolds,** General Chairman of the Committee on Arrangements, was making arrangements for the meeting, his wife was making arrangements for a new addition to his family. A new baby was expected momentarily.

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Attracting a crowd in the lobby of the Mayo was one of the neat, green and gleaming, single cylinder, oil test engines that CRC has developed. Manufactured by Laboratory Equipment Corp., this is one of 25 oil test engines which will eventually replace the currently used L-4 test engine.

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William Littlewood, SAE President, arrives in Tulsa for the Meeting with briefcase and a friendly smile

Two papers were presented by title only:

"Determination Of Diluent In Used Railway Diesel Lubricating Oils," by **L. L. Davis and H. E. Luntz,** Continental Oil Co.

"CRC Survey Of Antiknock Requirements Of Passenger Cars—1953" by **H. W. Best,** Yale University; **H. A. Bigley,** Gulf Research and Development Company; and **R. K. Williams,** General Motors Corp.

★ ★ ★ ★ ★

Members of the Mid-Continent Section of SAE come from long distances to attend sectional and national meetings. Many members travel over 200 miles per meeting. One section meeting, it was estimated, required over 200,000 man miles of travel.

at part throttle in 95% of the cars of one model. For models having maximum octane requirements at part throttle, the average difference between part and full throttle varied from 0.5 to 5 octane numbers. The maximum increase in any one car was 10 octane numbers. . .

. . . **H. W. Best, Yale University, H. A. Bigley, Gulf Research and Development Co., and R. K. Williams, General Motors Corp.,** "CRC Survey of Antiknock Requirements of Passenger Cars—1953."

Bearing Lubricants

75 millimeter bore, cylindrical, roller bearings were run dry at high speed and lubricated by a syrup-bonded coating of molybdenum disulfide applied before running, a molybdenum disulfide-air mist spray during operation, and a combination of both. No signs of wear or damage were present after the test. The maximum bearing temperature was 386 deg. F.

20 millimeter bore, tool steel, ball bearings were operated in a test rig at 2500 rpm, 110 pounds thrust load and temperatures of 100 deg to 1000 deg F. The solid lubricants were found to be better high temperature lubricants than the liquids. . .

. . . **Z. N. Nemeth and W. J. Anderson, Lews Flight Propulsion Laboratory, National Advisory Committee for Aeronautics,** "Temperature Limitations of Petroleum, Synthetic and other Lubricants in Rolling Contact Bearings."

Engine Combustion Photographed

High speed photographs (7200 frames per second) of the combustion process that takes place inside an engine cylinder confirm the belief that knock occurs immediately after a portion of fuel spontaneously ignites and burns extremely rapidly. Cylinder pressure rises so fast that supersonic shock waves impinge on the combustion chamber walls and is heard as knock. Both "cool" and "hot" flames may be photographed by this method in which a special engine with a quartz window head is used. . . .

. . . **G. A. Ball, Ethyl Corp.,** "A Quick Look At Engine Combustion."

Additives Evaluated

Propane fuel with 15% propylene gave satisfactory performance when used in six city buses operated for 25,000 miles each. There was no harm to the engine, or engine knock and little de-

posit build-up. Also, the propylene content of the fuel has no unusual or detrimental effect on crankcase lubricant. . .

. . . **J. E. Ebinger, Wichita Transportation Co., F. E. Selim, and R. W. Unterreiner, Phillips Petroleum Co.,** "Evaluation of The Effect of Propylene in Propane Used As A Motor Fuel."

Nitromethane can increase power output by as much as 13% when added to methyl alcohol and 7% when added to a benzene-isooctane mixture. Also, the indicated specific fuel consumption and indicated thermal efficiency increases.

The amount of nitromethan which can be added to a fuel is limited to 20% because of its tendency to cause pre-ignition. . .

. . . **E. S. Starkman, University of California,** "Nitromethane As A Piston Engine Fuel."

Diesel Fuel Deposits

Twenty thousand hours of testing six Diesel fuels in six automotive Diesel engines show that sulfur content, aromatics content, and average boiling point affect deposit and engine wear. Sulfur tends to increase deposits and wear over a wide range of operating conditions. Higher aromatics contents and average boiling points increase deposits at specific points in the engine, but have little effect on wear. But the best fuel composition for any situation depends upon the engine's design and the type of operation. . .

. . . **L. Eltinge, D. S. Gray, and H. R. Taliaferro, Standard Oil Company (Indiana),** "How Fuel Composition Affects Diesel Deposits and Wear."

Diesel Lubricants

High additive oils will increase Diesel engine life 2 or 3 times with less frequent oil changes. But this increase in oil drain periods depends primarily upon engine model, load, and fuel characteristics, particularly sulphur content. . .

. . . **J. W. Vollentine, Caterpillar Tractor Co.,** "Oil Change Periods In Diesel Engines With Series 2 Oils."

Oil diluent in Diesel engines can be determined by correlation with the decrease in flash and viscosity. This method is reasonably accurate. Correlation charts can be made from either experimental data or by calculation and estimation. . .

. . . **L. L. Davis, and H. E. Luntz, Continental Oil Company,** "Determination of Diluent In Used Railway Diesel Lubricating Oils."

Around the Meeting . . .

Professor E. M. Starkman, who presented a paper, told the session that he would speak a micro-century. To allay fears he explained that a micro-century was one hour plus or minus ten minutes going or coming from class at the University of California.

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The new lubricating oil test engine being developed by CRC was displayed by Mrs. C. S. Sundling, the manufacturer, and L. E. Bowen, one of its designers

For the smooth operation of the Meeting's technical sessions, SAE is grateful to chairmen:

W. K. Simpson, Electro-Motive Div., General Motors Corp.
D. R. Frey, Deep Rock Oil Corp.
M. M. Roensch, Chevrolet Motor Div., General Motors
J. E. Taylor, Gulf Oil Corp.

★ ★ ★ ★ ★

And for their services in recording the impromptu discussion at the session, SAE thanks to secretaries:

Wayne Faust, Universal Oil Products Co.
M. L. Alspaugh, Ethyl Corp.
W. G. Agnew, Research Laboratories Div., General Motors Corp.
F. A. Suess, Continental Oil Co.

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M. M. Roensch, Chevrolet Motor Division, and Chairman of the Friday morning session told a true story about a man who had recently been arrested for speeding. Before the Magistrate the man pleaded: "Honestly, Judge, I just filled my car with that new gasoline that gives 18% more power. Before I knew it I had gone over the speed limit." The Judge remarked that this was the best excuse he had heard in a long time and let the speeder go.

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Also in Tulsa at the same time as the SAE Fuels and Lubricants meeting was a celebration tribute to Will Rogers. Dignitaries present at the Claremore Roger's Memorial included **C. R. Smith,** President of American Airlines, **Thomas F. Ryan III,** Chairman of the Executive Committee, Braniff-International Airways, **Keith Kahle,** President of Central Airlines, and **Earl Johnson,** President of the Air Transport Assn.

Col. Vincent Retires

COL. JESSE G. VINCENT, President of SAE in 1920, and vice-president of Packard Motor Car Co., has retired after 42 years with Packard, which recently became Studebaker-Packard Corp. In the last 10 years, Col. Vincent has been developing "not only engines, but engineers" as his heritage to the company with which he started. He will continue as engine consultant for the Corporation.

About

F. P. ZIMMERLI has been named director of engineering and research for the Associated Spring Corp. He will assume his new duties January 1, 1955 and relinquish his position as chief engineer of the Barnes-Gibson-Raymond Division at that time.

Zimmerli has been a very active member of SAE since he joined the Society in 1927. He served as Vice-President representing Engineering Materials Activity in 1951 and is now on the Iron & Steel Technical Committee Panel C—Automotive, is Chairman of Iron & Steel Technical Committee Division XX—Shot Peening, and is Chairman of the Cold Wound Springs subcommittee of the Spring Committee.

He has also been active in the American Society of Metals, American Society of Testing Materials, and the Engineering Society of Detroit.

Zimmerli

Insley

ROBERT INSLEY has been appointed chief product engineer for the Aircraft Engine Division of Ford Motor Co. in Chicago. He has been manufacturing vice president of Continental Aviation & Engineering Corp. in Detroit.

Insley, who succeeds the late **RALPH DUBOIS** as chief product engineer, has been an aircraft engine design specialist for 34 years. He is well known for the book, **Aircraft Power Plants,** which he co-authored.

R. S. HARPER has been promoted by Goodyear Tire & Rubber Co. in Detroit to an account executive position, Manufacturers Sales. He has been serving as an automobile products representative.

Harper

Birdsell

ROGER BIRDSELL, vice president of the Yates-American Machine Co., Beloit, Wis., has been made a director of his company. He has been with the company for more than 20 years, starting as manager of the Radiator Division, now the Heat Transfer Products Division, when the division was formed.

COL. W. F. ROCKWELL, chairman of the board of Rockwell Mfg. Co., Pittsburgh, and Rockwell Spring & Axle Co., Coraopolis, Pa., was elected president of the Automobile Old Timers. He is one of five SAE members elected to executive posts by the organization. The others are **ALFRED REEVES,** advisory vice-president of the Automobile Manufacturers Association, who was elected a vice-president of the Old Timers; **ROBERT A. STRANAHAN,** president of Champion Spark Plug Co., a vice-president; **WILBUR SHAW,** president of Indianapolis Motor Speedway Corp., a vice-president; and **JOHN A. COLLYER,** chairman, The B. F. Goodrich Co., a member of the executive committee.

ROBERT A. HEATH is now chief engineer of the Muffler Division of Walker Mfg. Co. in Jackson, Mich. He had served as sales engineer for the same company.

JOHN R. TURUNEN has taken the position of test engineer in the Chevrolet Motor Division, General Motors Corp. in Detroit. Previously, he was junior research engineer with the Cadillac Motor Car Division of GMC and served as mechanical engineer in the U. S. Army at Savannah Ordnance Depot, Savannah, Georgia.

AIR COMMODORE F. R. BANKS has been elected to the Board of Directors of the Bristol Aeroplane Co., Ltd., Bristol, England. Banks was for many years technical manager and chief engineer of the Associated Ethyl Co., Ltd. and was responsible for the application of fuels to aviation engines. He is an acknowledged specialist in the development of aero engines, and is well known in most countries as an advisor on aviation matters.

Among his many honors, Banks is a Companion of the Bath, Officer in the Order of the British Empire, and a Fellow of the Royal Aeronautical Society.

SAE Members

J. L. ATWOOD, president of North American Aviation, Inc., Los Angeles, and SAE Vice-President representing Aircraft Engineering in 1945, has been elected a director of the Atomic Industrial Forum, Inc. of New York City.

Atwood

Romney

GEORGE ROMNEY has been elected chairman of the board, president and general manager of American Motors Corp. One of the nation's youngest top executives at 47, he succeeds **GEORGE W. MASON**, who died October 8. Romney has been serving as director and executive vice president of American Motors.

OTTO E. KIRCHNER, former director of operational engineering for American Airlines, has joined Boeing Airplane Co. in an engineering supervisory capacity to conduct commercial aircraft studies, it was announced by **EDWARD C. WELLS**, vice president—engineering.

Prior to his 20 years with American Airlines, Kirchner was an engineer with Ford Motor Co. when that firm was manufacturing the Ford tri-motor, and also worked for Fairchild Airplane Co. and Stinson Aircraft Corp.

He has also served on various government committees. Immediately after World War II he was U. S. scientific consultant for the Technical Industrial Intelligence committee, representing the American Transport Association in Germany. He is a Past SAE Vice President representing Air Transport Activity.

Kirchner

Sloan

ALFRED P. SLOAN, JR., chairman of the board of General Motors Corp., has been awarded the Hoover Medal, one of the highest awards in the engineering profession. The medal, given "for distinguished public service," was presented to Sloan at the annual dinner of the American Institute of Consulting Engineers, October 19.

The Hoover Medal is awarded periodically by a Board of Award composed of representatives of the national societies of civil, mining, mechanical and electrical engineers.

HERMAN L. WECKLER, who has held the position of vice president and general manager with the Chrysler Corp. in Detroit, now serves in the same position with the Clevite Corp. of Cleveland.

Weckler

Ford

WILLIAM CLAY FORD, vice-president of Ford Motor Co. and general manager of its Special Product Division, spoke at the conclusion of the first national meeting of the Lincoln Continental Owners' Club at Greenfield Village in Dearborn, Mich.

HERBERT IRVING CHAMBERS, formerly senior engineer in charge of electro-mechanical development for Electric Auto-Lite Co. in Toledo, Ohio, has taken the position of senior development engineer with the Consolidated Engineering Corp. of Pasadena, Calif.

B. E. HUTCHINSON, the one-time furnaceman who has guided Chrysler Corp.'s financial affairs since its beginning, decided that "the time has come for me to retire."

The 66-year-old financial expert said he wanted to retire as a director and chairman of Chrysler's Finance Committee Dec. 31. This would complete his retirement, begun last May when he stepped out as vice president and as the company's chief finance officer.

For 33 years, Hutchinson has played an important part in the automotive industry, and the imprint he made upon it will not be erased easily.

His determination and ambition cast Hutchinson in his youth as a furnaceman. Later he was an engineer after a fling at journalism.

JOHN J. DREGNER has been promoted to the position of chief engineer of the United Specialties Co. in Chicago. Dregner is replacing **DAVID EASTMAN**, who was also promoted to superintendent.

IRVING I. FELDMAN is now owner and president of the Kotcher Tool & Engineering Co. as well as the Aero Automobile Engine Co. of Detroit and Toronto, Ont., Can.

THEODORE W. BAYLER is now with Continental Aviation & Engineering Corp. of Detroit as a special assignment engineer. He had formerly been quality control engineer for Kaiser Motors Corp., also of Detroit.

American Airlines

Among the changes in function or location which have taken place at American Airlines in recent months are the following reassignments for a number of SAE members:

SAE President **WILLIAM LITTLEWOOD**, still located at Washington, now is vice president, research and development. He was vice president, engineering. **M. G. BEARD**, formerly chief engineer, is now assistant vice president, research and development, and is located at LaGuardia Airport Station, Flushing. **W. C. LAWRENCE**, formerly located at LaGuardia as director of engineering, is now assistant vice president, and chief engineer. His headquarters are at Tulsa. **E. H. RAIGUEL**, formerly development engineer at LaGuardia, is now in Tulsa as director of aircraft engineering. **T. J. HARRIS**, director, powerplant engineering at Tulsa, was development engineer of powerplants at LaGuardia. **R. A. MILLER** remains at Tulsa as manager, facilities. He was superintendent of shops at Tulsa. **W. R. NEELY** remains as project engineer, powerplants, at Tulsa. **F. M. MORRIS** remains at Tulsa as project engineer, materials. He had been development engineer. **J. T. FARRAH** remains as manager, industrial engineering at Tulsa. **P. M. BISHOP** is now regional supervisor, management development and employee relations, LaGuardia. He was staff engineer, equipment planning, New York. **G. H. BRINK** remains at LaGuardia as first pilot. He was previously chief engineering pilot.

W. W. DAVIES, one of United Airlines' top Western engineering executives, has resigned from the air carrier organization to establish his own industrial product design and general building plan and specification firm at San Carlos, Calif.

Davies was a 22-year veteran of U. A. L. and its predecessor, National Air Transport Company. He was manager of aircraft engineering at its San Francisco base at the time of his resignation.

A past Vice-President of the Society of Automotive Engineers, Davies was named last year to the nine-man Daniel Guggenheim Medal Board of Award. He is a graduate in architectural design of Illinois Institute of Technology and the Chicago Art Institute.

Offices of Davies' new firm have been established at 1900 Eaton Ave., San Carlos, on the San Francisco Peninsula.

Davies

Redding

JAMES D. REDDING is now staff assistant to the chief engineer of the Aviation Gas Turbine Division, Westinghouse Electric Corp. With headquarters at Kansas City, Mo., he will be responsible for engineering liaison on installation of jet engines. He went to Westinghouse following several years with the Department of Defense, where he was technical assistant to the Deputy Secretary of Defense for Research and Development. Redding will be SAE Vice-President for Aircraft in 1955.

JOHN J. HOUSE will serve as representative in Detroit, Mich., for R. G. LeTourneau, Inc., Longview, Texas. Previous to this appointment, House was government representative for ACF-Brill Motors Co. in Philadelphia.

House

Bird

WILLIAM J. BIRD has been elected vice-president in charge of sales of Plymouth Motor Corp., Chrysler Corp., Detroit. He has been continuously associated with Chrysler Corp. for the past 20 years, holding executive positions in the Dodge, Fargo, and Plymouth divisions.

HERBERT EARL JOHNSON, III is an assistant professor of mechanical engineering at the University of Wyoming in Laramie, Wy. He was formerly analytical design engineer with Pratt & Whitney Aircraft in East Hartford, Conn.

EDWIN E. PULS, lubrication engineer with Cities Service Oil Co., Detroit, won the grand award for his stamp collection at the annual Philatelic Society convention.

Puls' collection of letters mailed from the Nebraska Territory nearly 100 years ago also won first place in the class for previous first of grand award winners.

PAUL B. BENNER has recently been appointed chief engineer of the Decatur plant of Caterpillar Tractor Co. At this plant, scheduled for full production in the spring of 1956, the company will manufacture its line of motor graders and industrial wheel tractors. Benner, Chairman of the Central Illinois Section of SAE in 1949–50, has served in the engineering department of Caterpillar Tractor since 1935.

Benner

McCullough

CAROLL K. McCULLOUGH, who resigned as president of Pierce Governor Co., Anderson, Ind., early in 1954, has announced the formation of a new concern which will specialize in production of industrial and automatic governors and automatic controls. The new company, C. K. McCullough Co., Inc., has engaged in research and experimentation on radically new control devices for use in the automotive industry, and in general controls and related fabrication work.

RICHARD G. CUNNINGHAM has joined the Shell Oil Co. Research Laboratories at Wood River, Ill. as a research engineer. He previously was associate professor of engineering research at The Pennsylvania State University.

P. T. BRANTINGHAM has been transferred to the Chicago Foreign Operations division of International Harvester Co. He will serve as assistant manager of engineering with this division. In the Motor Truck division at Fort Wayne, Ind., he was divisional chief engineer.

CHARLES E. WOLMER has joined the Pennzoil Co. in Oil City, Pa. as manager of sales engineering. He formerly was petroleum technologist with American Cyanamid Co. in Stamford, Conn.

L. R. "MIKE" HACKNEY, has announced his resignation from the post of executive vice president, Air Transport Group, Inc., in order to return to industry as administrative assistant to the general manager of Fairchild Aircraft Division, Fairchild Engine and Airplane Corp., Hagerstown, Md.

HOLLISTER MOORE, manager, Sections and Membership Division, SAE, talked on "What's SAE? An Answer for Fleet Operators" at the meeting of the Equipment Development Committee of the American Trucking Association, October 22 at the Waldorf-Astoria. Moore pointed out that "the big benefit SAE membership offers to top-level technical men responsible for operation and maintenance of vehicle fleets is an opportunity for direct contact with the engineers who are designing and producing the vehicles. . . . SAE is not just a group of maintenance men swapping ideas with each other. It is broader than that. It is an organization whose membership represents every technical phase of automotive engineering—automotive transportation."

ARTHUR G. BAITZ has taken the position of district sales manager for the Fulton Sylphon Division and Bridgeport Thermostat Division of Robertshaw-Fulton Controls Co. with offices at Philadelphia, Pa. He was previously an application engineer at the Fulton Sylphon Division in Detroit.

J. E. TRAINER, executive vice-president and a director of Firestone Tire & Rubber Co., has been named a life member of the American Society of Mechanical Engineers. He was named a Fellow of the Society in 1942, and now joins the select ranks of those few members who have been given honorary life memberships.

THOMAS M. POTTS, who has been commercial accounts salesman for Esso Standard Oil Co. in Baltimore, is now industrial salesman for the Springfield, Mass. branch.

LESTER B. SEARER, JR. is now a salesman of automotive products for National Carbon Co. of New York City. He had served as sales engineer in that company.

ROBERT L. LAWLER is now associated with Allison Division of General Motors Corp. in Indianapolis as a detail engineer. He was a special assignment engineer for American Motors Corp. in Kenosha, Wis.

ALFRED A. GASSNER has been announced general manager of the new Fairchild Kinetics Division of the Fairchild Engine and Airplane Corp. with offices in New York City. Fairchild has absorbed Gassner Aircraft Engineering Co., a specialized consulting group, with 11 years of successful operation in the aircraft, electronics, railroad, reinforced plastics, and special machinery fields.

NATWAR M. PAREKH has moved to Tata Locomotive and Engineering Co., Ltd., Bombay, India as superintendent of Planning & Progress. Previously, he served as superintendent, Plant & Industrial Engineering with Ford Motor Co. of India, Ltd., which is also in Bombay.

HOWE H. HOPKINS has joined the Turbine Division of Continental Aviation & Engineering Corp., Detroit, as staff engineer. He is now serving as C.A.E. Representative at Societe Turbomeca, Bordes (B.P.), France, where he is supervising the production of Turbine Engines and Parts. He was formerly chief engineer, Constant Compression Engine Co., Philadelphia, Pa.

Hopkins

Davies

ROBERT H. DAVIES has received the appointment of vice president in charge of engineering for The Parker Appliance Co. and its subsidiaries. Davies, engineering manager of the firm since 1946, has been responsible for supervising the design and development of most of Parker's expanded product lines in the hydraulic and fluid system field.

C. A. GRECO is a stress analyst with North American Aviation, Inc. He was stress analyst for Kaiser Metal Products, Aircraft Division in Bristol, Penn.

Continued on page 97

SAE Father and Son

Past-President WILLIAM R. STRICKLAND (L M '12) and his son, RANDOLPH L. STRICKLAND (A '41) appear on a test trip for Cadillac Motor Car Division of General Motors in August, 1927. The car shown is one of the two first off the assembly line of the 1928 models. In March, 1886, William Strickland crossed this same Independence Pass in a sledge, which tipped over near the top of the pass.

Randolph is now a resident engineer with the Detroit Aluminum & Brass Corp. His father is retired and is residing at La Salle Blvd., Detroit.

Obituaries

JOHN OLDHAM HUSE

John Oldham Huse, vice president and sales manager of Chrysler Motors Parts Corp., Chrysler Corp., Centerline, Mich., died in September. He was fifty-seven.

Huse became a member of SAE in 1947. He was also a member of the Society of Naval Architects and Marine Engineers, the American Society of Naval Engineers, and the Newcomen Society.

He attended the U. S. Naval Academy at Annapolis, from 1915 to 1918, and then obtained his M.S. from Columbia University in 1924. Later he spent a year at the Technische Hochschule in Charlottenburg, Germany.

From 1918 until retirement, Huse was in the employ of the U. S. Navy, rising from the position of engineering officer to director of the Naval Shipyard in Philadelphia. In 1948, he joined Chrysler Corp. as a member of the Staff of the General Manager. Then he changed to the Parts Division as sales manager in 1950. He became vice president and general manager of Chrysler Motors Parts Corp. in 1951.

RALPH H. LANGNER

Ralph H. Langner, partner of Langner & Rifkin, Inc., Sacramento, Calif., died of a heart attack June 13. He was 72 years of age.

Langner was born in Oak Harbor, Ohio and attended grade school in Sacramento, Calif. He started in business in 1902 as a partner in an automobile garage. In 1910 he joined Kimball Upson Co., Sacramento in the position of shop manager. From Kimball he moved into the partnership of Furrer, Langner, Kinnear, now known as Langner & Rifkin.

He became an Associate member of SAE in 1945.

BERNARD W. COGHLIN

Bernard W. Coghlin, president and manager of B. J. Coghlin Co., Ltd. of Montreal, Que., Can., died April 5. He was 81.

Coghlin had been an Affiliate Member Representative of B. J. Coghlin Co., Ltd. to SAE from 1919 until 1948, when he became an Associate member. He had been an active member all thirty-five years.

He was born in Montreal and was a citizen of Canada. He was president and manager of B. J. Coghlin Co. since 1919.

CHARLES GILLIS

Charles Gillis, service manager of Freuhauf Trailer Co., Seattle, Wash., was drowned May 19th while fishing in the Middle Fork of the Snoqualmie River in western Washington. Gillis was 39 years old at the time of his death.

He attended Freuhauf Technical School from 1947 to 1951, when he became service manager of Freuhauf Trailer Co. Previous to this he served as a welder and mechanic for G. F. Atichson, Inc.; Coast Equipment, Inc.; and Webster Welding, Inc.

Gillis had been an Associate member of SAE in the Northwest Section since 1953.

WILLIAM WOODWARD SLOANE

William W. Sloane, vice president of the Goodman Mfg. Co., Chicago, died September 8. He had been a member of SAE since 1925.

Sloane was born in Canajoharie, N. Y., Oct. 17, 1885. He went to grade school and high school in Canajoharie and then enrolled in the International Correspondence School of Mining and Electrical Engineering.

His career in engineering started in 1902 when he joined General Electric Co., Schenectady, N. Y., as a draftsman. In 1906 he moved to Western Electric Co., Chicago, in the same position. He became engineer of Sloane Motor Co. in 1908; superintendent of Peerless Accessory Mfg. Co. in 1911; and assistant chief engineer in Goodman Mfg. Co. in 1913.

Sloane served with Goodman Mfg. Co. for over 40 years, moving from assistant chief engineer up to vice president, which position he held when he died.

FRED W. CEDERLEAF

Fred W. Cederleaf, director of engineering, Ingersoll Products Division, Borg-Warner Corp., Kalamazoo, Mich., died Sept. 24. He had been a member of SAE since 1919 and was Vice-President, representing Production Engineering, 1933.

Cederleaf was born in Jonkoping, Sweden in 1888. He became a citizen of the United States and attended Central High School in Detroit. He then went to technical school, taking the Mechanical Course.

He started his business career in 1914 as chief die designer with Studebaker Corp., Detroit. Among the positions that he held in his career are: works manager for Muncie Products Division, General Motors Corp.; production engineer with Buick Motor Co.; standards manager for General Motors of Canada, Ltd.; works manager of Dodge Mfg. Corp.; works manager for Detroit Transmission Division, General Motors; assistant to the president of Borg-Warner Corp.; and director of engineering, Borg-Warner Corp., the position he held at the time of his death.

JIMMY MAIR

Jimmy Mair, Associate member of SAE since 1953, died August 27. He was president of Mair's Brake & Clutch Service, Montreal, Que., Can.

Mair was born Nov. 24, 1899 in Glasgow, Scotland and attended grade school and high school in Scotland from 1905 to 1916. Upon moving to Montreal, Can., he became a citizen of Canada.

From 1939 to 1947, he served as field engineer for Eastern Canada with Hastings Mfg. Co., Hastings, Mich. But he left Hastings in 1947 to set up Mair's Auto Supplies Co., now known as Mair's Brake & Clutch Service.

Mair was an honorary member of the Society of Fleet Superintendents in Montreal.

FRANK E. MILLER

Frank E. Miller, who was sales engineer for Pennsylvania Hardware Mfg. Co., Ardmore, Pa., died July 24 after an eight months illness. He became a member of SAE in 1944.

Miller was born June 25, 1914 in Scranton, Pa. He took the scientific course in Central High School in Scranton and then attended the Engineering extension of Pennsylvania State College from 1933-36 and 1939-40.

He started in industry as a designer and detail draftsman with Wesel Mfg. Co. of Scranton in 1936. With Hendrick Mfg. Co. and Pitcairn-Larsen Autogiro Co., Inc., he continued the

same work. Then in 1945 he was project engineer for Kellett Aircraft Corp., Camden, N. J. From then until 1951, he served in engineering positions with Rheem Mfg. Co.; Kaiser Fleetwings, Inc.; Franklin Institute; International Staple & Machine Co. and Pemco Engineering & Mfg. Co.

Miller became a member of SAE in 1944.

GEORGE W. PONTIUS, III

George W. Pontius, III died in August. He was forty-five years old, born in Seneca Falls, New York, July 9, 1910.

He started in industry with Bendix Products Division, Bendix Aviation Corp. as laboratory technician and draftsman in 1931. By 1948, he was manager of automotive engineering and was automotive manager at the time of his death.

Pontius became an Associate member of SAE in 1948.

ELMER SIEGLING

Elmer Siegling, consultant, Thompson Products, Inc., Cleveland, died Sept. 26. He had been a member of SAE since 1938.

Siegling was born in Holbrook, Iowa in November, 1892 and attended the State University of Iowa from 1913 to 1918. He graduated with a B.S. in Mechanical Engineering.

He served in the U. S. Army Engineering Corps after graduation and then took a position as engineer with Bailey Meter Co., Cleveland in 1919. In 1923 he moved to Cleveland Electric Illuminating Co. as test engineer. After three years with this company, he joined Thompson Products and remained in their employ until the time of his death. During those 28 years, he served as engineer, manager of the Piston Ring Division, and finally, consultant.

Besides his assocation with SAE, Siegling was also a member of the National Aeronautical Association and an Associate member of the Cleveland Engineering Society.

LEO F. STONE

Leo F. Stone, president of the Grico Two Axle Drive Co. in Detroit, died in March. He was fifty-six.

Stone had been president of Grico Two Axle Drive since 1937 and acted in supervisory capacity of many new developments in tandem drives and trailing axle developments.

He was born in Detroit in 1899 and attended Campbell School from 1914 to 1917. He became an Associate member of SAE in 1947.

JACK C. AKERS

Jack C. Akers, fleet superintendent of St. John's Motor Express, Portland, Oregon, died July 27. He was 50.

Akers became a member of SAE in 1950 and was also a Journeyman Machinist in the International Association of Machinists.

In 1926 he started as shop foreman for the M & O Auto Service in Muncie, Ind. He moved to Lewis Super Service as assistant service manager in 1930. In 1933 he joined Pierce Auto Freight Lines, Inc. as maintenance superintendent and became maintenance engineer in 1951. He had just joined St. John's Motor Express at the time of his death.

GEORGE WALTER MASON

George Walter Mason, president and chairman of the board, American Motors Corp., Detroit, died October 8. He was sixty-four.

He was born in Valley City, North Dakota and attended the University of Michigan, graduating in 1913 with a B.S. degree in Engineering and Business Administration.

His start in the automotive industry came when he joined Studebaker Corp. in 1913. In 1919, he took the position of works manager with Chrysler Corp. By 1926, he was serving as vice president of Copeland Products Corp. and became president in 1927. Following this appointment, he served as president of Kelvinator Corp., Nash-Kelvinator Corp., and American Motors Corp. He was also chairman of the board of both Nash-Kelvinator and American Motors.

Mason wanted to produce a small, light-weight passenger car that would be minimum-cost transportation, measured in dollar investment and cents-per-mile operating costs. Against the wall of postwar inflation and a managed economy, he found the struggle an exhausting one. He was advised by some of the most successful men in the industry to abandon the idea. But he continued his assault on the idea, going to Europe for cheaper operating costs, seeking to obtain in this country the co-operation of the other independents to pool their abilities and facilities to help him.

He became a member of SAE in 1947 and had also been President of the Automobile Manufacturer's Association since 1946.

GEORGE H. TABER, JR.

George H. Taber, Jr., member of SAE since 1925, died August 20. He had been acting as consulting engineer with offices at 116 E. 30th St., New York.

Before his work as consulting engineer, Taber was a member of various divisions of Sinclair Refining Co. for 30 years. He was manager of the Gasoline Department, Sinclair Oil & Gas Co. in Tulsa in 1917 and became vice president in 1919. In 1921 he became president of Sinclair Crude Oil Purchasing Co. He moved to Sinclair Refining Co., New York, as vice president in charge of manufacturing in 1923 and was elected president in 1947.

Taber attended the University of Pennsylvania, receiving a B.S. in Mechanical Engineering in 1911. He then went to Massachusetts Institute of Technology and was given his M.S. in Chemical Engineering in 1913. He was an Associate Member of the American Society of Mechanical Engineers, a Member of the American Chemical Society, a Member of the American Electrochemical Society, and a Member of the Engineer's Society of Western Pennsylvania.

Taber was sixty-five years of age when he died.

L. H. CLARK

L. H. Clark, partner and sales manager, Airdrome Parts Co., Inglewood, Calif., died June 12. He had been an Associate member of SAE since 1952.

Clark served as an expediter for North American Aviation in Los Angeles in 1945. In 1946 he joined Collins Engineering Co., Culver City, Calif. in the position of sales manager. From 1950 until the time of his death, he was partner and sales manager for Airdrome.

He was born in Table Rock, Nebraska, July 7, 1918.

DONALD E. CRABB

Donald E. Crabb, owner of Crabb engineering Co. in Detroit, died in March. He was 59 years old and had been an Associate member of SAE since 1927.

His business career started in 1915, when Crabb joined the Shop Equipment Department of the Chas. H. Elting Co. in Chicago. In 1921 he became clerk and liaison engineer with Dodge Bros. Corp. in Detroit and served in that position until 1929, when he moved to Buffalo. There he worked in the Design and Sales Department until 1934. From 1934 to 1937 he held the same position with Atwood Vacuum Machine Co. of Rockford, Ill. Then he took the position of sales engineer in Palnut Co., Irvington, N. J.

Crabb organized the Crabb Engineering Co., located in Detroit, in 1944 after leaving Palnut. He was owner of Crabb Engineering until the time of his death.

Besides being Associate member of SAE, Crabb was a member of the Engineering Society of Detroit.

TECHNICAL COMMITTEE *Progress*

1954 SAE Technical Board

W. M. Walworth, Chairman

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B. B. Bachman	E. G. Haven
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B. G. Van Zee

Groups in Action to Revise Involute Spline Standards

EXPERIENCE with involute splines over a period of years has indicated the need for a few changes in both the SAE Standard and the American Standard on splines. The indicated changes stem from a need for getting economy and for incorporating into the standards a better system of tolerances and fits, in keeping with modern production and gaging practices.

Both the Involute Splines and Serrations Subcommittee, of the SAE Parts and Fittings Committee, and Subcommittee 1 of ASA Sectional Committee B5 are working on the revisions. (SAE is a co-sponsor of ASA Sectional Committee B5.) George L. McCain, of Chrysler, heads both the SAE subcommittee and the ASA subcommittee.

To understand better the need for the changes, let's first look at what the involute spline standards consist of and how they have been used.

During the few years between 1941 and 1945, the need for a standard was accented by World War II demands on industry. The first standard, issued in 1946, was based on practices developed in production and inspection of gears. In the first standard, the addendum and dedendum were made to agree with the practice on stub pitches for gears. Each was made equal to the reciprocal of the stub pitch, with the result that the external member required chamfering to clear the fillet of the internal member, on major diameter fits. For side bearing fits, the addendum of the external member was reduced to clear the fillet, resulting in some loss of contact height.

Between 1946 and 1949, the aircraft industries took a very active interest in the standard. The ASA subcommittee was expanded to include members from both the aircraft engine group and the airframe group on the West Coast. The aircraft engine group had developed a standard which had no recommended fits and nothing except a flat machining tolerance for defining the limits for inspection.

In 1946 a new standard was issued entitled "Gear Tolerances and Inspection," which supplied a realistic approach for setting up maximum permissible variations of profile, tooth spacing, lead and out of roundness.

As a result of three years of meetings, a revision was finally approved, incorporating three classes of fits on the major diameter, the minor diameter, and the sides of the teeth. The minor diameter fit was a carry over of the old practice, on straight parallel sided splines, of grinding the internal minor diameter to fit the form ground minor diameter of the external splined member.

The 1950 edition, which resulted

Materials Men Explore Molybdenum Mining

The SAE Aeronautical Materials Specification Division wound up its meeting in Denver last September by visiting Climax Molybdenum's mine in Climax, Colo. It's been said that molybdenum is the second most important alloying element in high-strength steels for aeronautic use (nickel is first). That's one reason why the AMS group was eager to see how molybdenum is extracted and processed.

from this work, also included extra dedendum depth for the flat root type, so as to make all types interchangeable, except that a flat root internal was required for a major diameter fit.

Interchangeability between flat root and fillet root types has not been so important as at first considered. That's because different tools are required for each. The subcommittee has recently decided to drop the interchangeable feature and make each type meet its own requirements. This meant that the flat root type could be changed back to the 1946 dedendum because of its economy of broaching. Also some bearing contact could be sacrificed because in automotive and machine tool applications the loading is not so critical as in aircraft.

Experience has shown also that loose and press fits are seldom, if ever, used in major diameter fits. And when press fits are used on the sides of the teeth, they are usually so critical that no standard could fit the many conditions existing. For these reasons then, the following decisions have been made by the subcommittee:

1. Delete the minor diameter fits.
2. For the flat root only, change the dedendum of the internal to $1/P_s$, (reciprocal of the stub pitch). This carries with it the decision to modify the major diameter of the external as needed.
3. Apply form clearance for both external and internal.
4. Delete specifications for flat root fillet radius and have values in a table for reference.
5. Delete the loose and press fits on the major diameter (Classes I and III).
6. Delete the press fit on the sides of the teeth (Class C).
7. Change definitions and symbols to agree, where possible, with latest standards on nomenclature.
8. Delete the use of flatted pins and use round pins of larger diameter, as in the Gaging Standard.
9. Incorporate with the revision, the Standard on Spline Gaging (B5.31) with revisions which may be necessary because of the above changes.
10. Make pin measurements optional and reference, because with good gaging practice, the space width and tooth thickness are the required specifications. (Tables of pin measurements will be included in the Standard.)

In addition to the decisions listed, some consideration is being given to revision of the Involute Serration Standard paralleling those being considered for the Spline Standard. Since the Gaging Standard covers both splines and serrations, it might simplify the overall problem to include the serrations with the splines and gaging into one standard. A second method would be to make the Serration Standard, with its Gaging, as a separate standard. This would involve some duplication but might prevent confusion.

Most important of the revisions

continued on page 103

Small Turbine Engines Subcommittee Organizes

THE Small Turbine Engines Subcommittee has tentatively decided to take for its province aircraft turbine engines up to 1000 hp or equivalent.

The Subcommittee is a subsidiary of Committee E-25, Engine and Propeller Standard Utility Parts of the SAE Aircraft Engine Division. Second meeting of the Subcommittee was held October 18.

R. L. Keene
Chairman

Already appointed to the Subcommittee are: R. L. Keene, chairman, General Electric; J. L. Burnham, Lycoming; J. D. Cregan, Aircooled Motors; J. B. Cooper, AiResearch; C. J. Faust, Fairchild; W. B. Gurney, Solar; J. P. Lidral, Boeing; and J. E. Wolf, Marquardt.

Fall Meeting of Shot Peening Sub-Committee

Gathered around the conference table at the fall meeting of Division XX—Shot Peening at Hot Springs, Va. are: (left to right around the outside of the table) F. R. Gladwin, H. C. Ripper, W. E. Sword, J. R. McConnell, Robt. H. Briggs, Dennis Sandy, R. C. Sackett, F. P. Zimmerli, Ch. Div. XX, Fred Landecker, John J. Bush, W. M. Wood, Verne W. Nichols, H. J. Noble, W. L. R. Steele, J. C. Straub, J. H. Clark, E. E. Alexander, P. F. Ulmer, W. G. Patton, Tore Franzen, J. R. Gustafson and C. E. Edwards. Others who attended the meeting are: E. E. Hawkinson, Microblast Mfg. Corp.; George P. Gohn, Bell Telephone Labs.; Dr. Horace Grover, Batelle Memorial Institute; J. H. Jones, Republic Steel Corp.; Richard O. Straight, Cargill Detroit Co.; A. P. Neuman, Vapor Blast Mfg. Co.; R. S. Komarmitsky, Rockwell Spring & Axle Co.; C. D. Gill, American Wheelabrator & Equipment Corp.; Z. Arkus-Duntove, Chevrolet Motor Division of GMC; and Victor F. Stine, Pangborn Corp.

Besides considering standardization projects, the Division heard and discussed four technical papers. Division XX is a subgroup of the SAE Iron and Steel Technical Committee

Gordon . . .

. . . delivered first L. Ray Buckendale Lecture, Nov. 1, at meeting sponsored by Detroit Section's Junior Activity

Kenneth W. Gordon (center), Dodge Division of Chrysler Corp., received the first L. Ray Buckendale Lecture Award from SAE Past-President Dale Roeder, chairman of the Award Committee, at SAE Detroit Section's Junior Meeting on November 1. Harry Chesebrough, chairman of Detroit Section, looks on

Kenneth W. Gordon, project engineer in Dodge's Truck Division, delivered the first L. Ray Buckendale Lecture on Nov. 1, 1954, at a meeting sponsored by the Junior Activity of the Detroit Section of the Society of Automotive Engineers, held at the Rackham Educational Memorial, Detroit.

The L. Ray Buckendale Lecture, sponsored by the Society of Automotive Engineers, has been established to commemorate the contributions of the 1946 SAE President as a developer of the latent abilities of young men and as an authority in the theory and practice of gearing, particularly as applied to automotive vehicles. A cash award and certificate are provided for an annual lecture and monograph by a distinguished authority in the technical areas of commercial or military ground vehicles for either on- or off-road operation.

The Lectures are directed toward filling the needs of young engineers and students for up-to-date practical knowledge. Establishment of this new lecture series results from SAE Council's acceptance of a proposal of the Timken-Detroit Axle Charitable Trust No. 2 that SAE establish and administer an L. Ray Buckendale Lecture series with funds provided for that purpose by the Trust.

In keeping with these aims, Gordon's lecture dealt with "Design, Evaluation, and Selection of Heavy-Duty Rear Axles." In it he laid down "ground rules" for the design, evaluation, and selection of automotive axles.

Design problem pertinent to the four chief functions of an axle were discussed . . . and some useful approximations outlined. Gordon delved into: (1) axle ability to carry load, (2) axle capacity to transmit driving force, (3) matters pertaining to the differential, and (4) the system for producing deceleration.

The award and certificate were presented to Gordon by SAE Past-President Dale Roeder, chief engineer, Tractor Division, Ford Motor Co., who is chairman of the L. Ray Buckendale Lecture Committee. Roeder was introduced by William S. Coleman, Research Laboratories Division, General Motors Corp., who is assistant vice-chairman of Detroit Section's Junior Activity and chairman of its Junior Group. Assisting him in the session's arrangements were C. T. Langley, vice-chairman, Junior Activity, Timken-Detroit Axle Division, Rockwell Spring and Axle Co.; R. L. Wiltse, Chrysler Corp., program chairman; T. E. Coon, Packard Motor Car Co., meeting operation chairman; J. A. Crabtree, Eaton Mfg. Co., publicity, and J. R. Splitstone, Timken Roller Bearing Co., photographs.

The Lecture was well attended by students and young engineers to whom the Series is directed. It was preceded by a tour of the Dynamometer Laboratory of Rockwell's Timken-Detroit Axle Division and a dinner. Walter W. Belson, assistant to the president and director of Public Relations, American Trucking Associations, Inc., was a humorous and inspirational dinner speaker.

New Format for Aero Meeting . . .

. . . outlined by General Chairman R. E. Johnson. N.Y.'s Statler will be scene of 18 technical sessions and round tables, a display, and a dinner dance, April 18-20. Seven production panels will wind up the Meeting on April 21 at the Hotel McAlpin

NEXT spring's SAE Golden Anniversary Aeronautic Meeting is going to be more useful to the industry than any ever held in New York, if General Chairman Robert E. Johnson of Wright Aeronautical and his committeemen have their way.

They have planned three days of technical sessions and round tables—April 18 devoted to propulsion, April 19 to air transport, and April 20 to problems of the military services—at New York's Statler Hotel. Each day there will be a luncheon at which an authority on the theme of the day will be principal speaker. To pack more service to aeronautical engineers into these three days, each day will feature six technical sessions and round tables—three simultaneously in the morning (two sessions and one round table) and

Neyhart . . .

. . . '54 Beecroft Memorial Lecturer

Prof. Amos E. Neyhart, of The Pennsylvania State University's Institute of Public Safety, presented the 1954 Beecroft Memorial Lecture on October 18 before 300 participants in the National Safety Congress in Chicago. Neyhart was named to receive the 1954 Beecroft Memorial Award "in recognition of a substantial contribution to the safety of traffic involving the use of motor vehicles."

This is the eighth of ten such awards to be made as a result of a bequest of $2500 to SAE in the will of the late David Beecroft who was president of the Society in 1921.

Neyhart's address was entitled "Driver Education—The Key to Safe Operation of Motor Vehicles." (The complete text of the address appears in the November issue of SAE Journal, beginning on page 67.) J. N. Bauman, chairman of the Beecroft Award Committee and vice-president of White Motor Co., presented the Award certificate and a check for the $250 which the Award entails.

Prof. Amos E. Neyhart

three more simultaneously in the afternoon. Timely topics have been chosen from a list of 160 suggestions and arranged so that sessions held simultaneously will appeal to different groups.

Unlike previous Aeronautic Meetings, this one will have all sessions open to all SAE members and guests, without requirement for presentation of security clearance. There will be no evening technical sessions.

April 21 will be devoted to an SAE Aeronautic Production Forum planned around the theme "Meeting Competition Through More Efficient Production." The forum will be held at the Hotel McAlpin. In each of seven different production fields, there will be a panel of experts on hand all day to explain latest developments and answer questions put forth by the audience. The forum will also feature a luncheon addressed by a top production authority.

Participants in both the technical sessions and the Production Forum will have a chance to meet socially—and wives will have a chance to meet husbands' colleagues—at a dinner dance in the Statler ballroom Wednesday evening, April 20. Such gatherings have become a regular and much enjoyed feature of West Coast SAE Aeronautical Meetings, but they are new to the New York meeting.

Throughout the four-day meeting, suppliers to the aviation industry will exhibit their wares to meeting participants in an enlarged Aircraft Engineering Display.

YOU'LL . . .

. . . be interested to know that . . .

SOME 20 SAE Sections already have set the dates of their Golden Anniversary Meetings. They will celebrate SAE's 50th birthday in various ways—technical sessions, student programs, and ladies' nights . . . all keyed to the forward-looking theme of the challenge ahead as the Society enters its second 50 years of activity.

★ ★ ★

MONTREAL SECTION has recently appointed its first vice-chairman for Student Activities. . . .

★ ★ ★

HORNING MEMORIAL Board of Award rules have been changed so that only papers written by one or by two authors may be eligible for the award. Previously there was no limit on the number of joint authors.

Automotive . . .

. . . Ordnance Day, Feb. 28, will feature an all-day technical meeting and plant tours through Detroit Arsenal

"AUTOMOTIVE Ordnance Day," scheduled to be celebrated with an all-day SAE Golden Anniversary meeting on Monday, Feb. 28, 1955, at the Detroit Arsenal, Center Line, Mich., will be sparked by a talk by Gen. E. L. Cummings, Chief of Ordnance, U. S. A. A trip through the Arsenal and its new engineering facilities will be one of the features. The event will immediately precede the three-day SAE Golden Anniversary Passenger Car, Body and Materials Meeting to be held at the Sheraton-Cadillac Hotel, Detroit, March 1-3.

The meeting will feature papers describing Ordnance facilities for development of Army vehicles; use of

SAE NATIONAL MEETINGS . . .

January 10-14, 1955
Golden Anniversary
Annual Meeting and
Engineering Display
The Sheraton-Cadillac Hotel
and Hotel Statler, Detroit, Mich.

March 1-3, 1955
Golden Anniversary
Passenger Car, Body and
Materials Meeting
The Sheraton-Cadillac Hotel,
Detroit, Mich.

March 14-16, 1955
Golden Anniversary
Production Meeting and Forum
Netherland Plaza, Cincinnati,
Ohio

April 18-21, 1955
Golden Anniversary Aeronautic
Meeting, Aeronautic Production
Forum, and Aircraft Engineering
Display, Hotel Statler and
McAlpin Hotel, New York, N. Y.

June 12-17, 1955
Golden Anniversary
Summer Meeting
Chalfonte-Haddon Hall,
Atlantic City, N. J.

August 15-17, 1955
Golden Anniversary
West Coast Meeting
Hotel Multnomah, Portland,
Ore.

September 12-15, 1955
Golden Anniversary
Tractor Meeting and
Production Forum
Hotel Schroeder, Milwaukee,
Wis.

October 11-15, 1955
Golden Anniversary
Aeronautic Meeting
Aircraft Production Forum,
and Aircraft Engineering
Display
Hotel Statler, Los Angeles, Calif.

October 31-November 2, 1955
Golden Anniversary
Transportation Meeting
The Chase, St. Louis, Mo.

November 2-4, 1955
Golden Anniversary
Diesel Engine Meeting
The Chase, St. Louis, Mo.

November 9-10, 1955
Golden Anniversary
Fuels and Lubricants Meeting
The Bellevue-Stratford
Philadelphia, Pennsylvania

titanium for military purposes; military equipment in the atomic age; and the use of automatic computers in the solution of vehicle problems.

Col. G. Petersen, Ordnance Corps, will be chairman of the morning session. C. F. Bachle, vice-president in charge of research, Continental Aviation & Engineering Corp., will chairman the afternoon session.

In addition to the technical sessions, there will be five tours through the Arsenal, arranged periodically between 10:00 a.m. and 4:00 p.m. An outstanding feature of the tour will be a trip through the Arsenal's new Engineering Laboratory Building, which houses the engineering and laboratory activities.

The committee in charge of arrangements is chairmanned by Mr. Bachle. Other members are: H. E. Chesebrough, Chrysler Corp.; E. N. Cole, Chevrolet Motor Division, GMC; C. V. Crockett, Cadillac Motor Car Division, GMC; Col. G. Petersen, Ordnance Corps; J. A. Swint, Tank Division, Ford Motor Co.; M. A. Thorne, Vehicle Development, GMC; C. C. Utz, Chrysler Corp.; John A. C. Warner, secretary and general manager, SAE; and I. H. Williams, Fisher Body Division, Tank Plant, GMC.

SAE Golden Anniversary Annual Meeting

The Most Important Meeting in the Society's History . . . will feature an event-packed program geared to the look-ahead theme of the SAE's 50th birthday celebration.

★ **C. F. "Boss Ket" Kettering** will forecast "The Next Fifty Years" at the banquet

★ **P. M. Heldt,** one of SAE's earliest pioneer members, will receive a tribute for igniting the spark that gave birth to SAE

★ **The SAE Golden Anniversary March** will be played on the organ by its composer, Macy Teetor, and a full orchestra

★ **More than 40** other outstanding technical papers

★ **Golden Anniversary celebration** will flavor the engineering display as well as all other aspects of the Meeting

★ **Atomic Energy's role** in the automotive industry's future will be on the program for the evening of Tuesday, January 11

★ **Ten of the 12 Golden Anniversary** Journal articles on the look-ahead in automotive and aeronautical engineering will be presented by their authors

The Sheraton-Cadillac Hotel Hotel Statler Detroit Masonic Temple

January 10-14, 1955

SAE Section Meetings

Atlanta—Jan. 3

Ship-A-Hoy Restaurant. Dinner 7:00 p. m., meeting 8:15 p. m. Lubricants, plus a talk on SAE Anniversary —C. M. Larson, Sinclair Refinery.

Canadian—Dec. 15

Royal York Hotel, Toronto, Ont. Dinner 7:00 p. m. Pete McGillan, Toronto, Telegram. This is our annual Bob Combs Night.

Cleveland—Dec. 13

Lake Shore Hotel, Transp. & Maint. meeting.

Detroit—Dec. 13

Rackham Educational Memorial. Dinner meeting. The Thunderbird—Representative from Ford Motor Co. Panel meeting—Speed vs. Streamlining.

Metropolitan—Dec. 14 and Jan. 6

Dec. 14—Kohler's Swiss Chalet, Rochelle Park, New Jersey. Dinner 6:30 p. m., meeting 7:30 p. m. Dinner $3.00 per person. How Jet's Magic Eye Beats Foe's Bullets—W. P. Bush, asst. to the chief engr., Republic Aircraft Corp.

Jan. 6—The Brass Rail, Fifth Avenue & 41st St. Cocktail hour 5:30 p. m., dinner 6:30 p. m., meeting 7:45 p. m. Description, Operation Cost, and Performance of Railroad Diesel Cars—Representative of The Budd Co.

Mohawk-Hudson—Dec. 14

Circle Inn, Latham, N. Y. Dinner 6:45 p. m., meeting 8:00 p. m. The Automotive Gas Turbine—What is its Future?—Panel of SAE members lead by D. H. Brown, dev. engr., General Electric Co.

Montreal—Dec. 13

Sheraton Mount Royal Hotel. Dinner 7:00 p. m., meeting 8:00 p. m. Gas Turbines or Piston Engines—Max M. Roensch, Chevrolet, GM, Detroit.

Philadelphia—Jan. 5

Engineers Club. Dinner 7:00 p. m., meeting 8:00 p. m. Joint meeting with I.A.S.

St. Louis—Dec. 14

Gatesworth Hotel, St. Louis. Dinner 7:00 p. m., meeting 7:45 p. m. Dramatic Achievement of Gas Turbine Engines and Their Impact on Civilization —J. M. Pederson, mgr. of Marketing at General Electric Co., Evendale, Ohio Plant.

Syracuse—Jan. 10

Syracuse Museum of Fine Arts. Dinner 6:30 p. m., meeting 8:00 p. m. Atomic Energy Reactors & Motive Power—Dr. George Manov, Atomic Energy Commission.

Texas—Jan. 14

Aircraft Engines.

Texas Gulf Coast—Jan. 14

Ye Old College Inn, Houston. Business meeting.

Twin City—Jan. 12

Curtis Hotel, Minneapolis. Dinner 6:45 p. m., meeting 8:00 p. m. Vibration and Noise Elimination in Outboard Motors—L. E. Haas, chief engr., Scott-Atwater Co., Minneapolis, Minn. Work Equipment Hydraulic Systems—S. H. Knight, supv. work equipment, No. Pacific Railway Co., St. Paul, Minn. This meeting is Home Talent Night.

Williamsport—Jan. 3

Moose Club Auditorium. Dinner 6:30 p. m., meeting 8:00 p. m. W. T. Piper, Sr., pres., Piper Aircraft Corp., Lock Haven, Pa.

This is not a complete list of all Section Meetings. It includes only those meetings for which we have received sufficient advance notice to permit listing.

New Carbon Removal Method Restores 70-80% Power Loss

Based on paper by

H. W. SIGWORTH

and

R. K. STONE

California Research Corp.

A safe, economical, and easy method of removing combustion chamber deposits has been developed by California Research Corporation. The new treatment—called PDQ Carbon Remover—uses a special fuel which removes the deposits as it burns.

The method seems to show 70 to 80% recovery of power loss due to combustion chamber deposits. There's an indication, too, that removing the deposit lowers the engine's octane requirement.

The PDQ Process—What it is

PDQ Carbon Remover is administered with the car parked and the engine idling. The fuel line is blanked off between the fuel pump and the carburetor and the special fluid is fed by gravity directly to the carburetor float bowl, as illustrated in Fig. 1.

The throttle is rapidly depressed and held for about one second, while the engine accelerates up to 3000 rpm. Then it is released and the engine returns to idle speed. This is repeated until the fluid is consumed—about ten minutes.

For best results the throttle must be opened wide each time and not held down too long. Standard treatment is about 30 openings. Fig. 2 shows what the engine looks like before and after such a treatment. Since the process is designed for normal conditions, it will be less effective at altitudes above four thousand feet and at temperatures lower than 40 degrees F.

It is considerably less expensive than the current practice of removing the cylinder head and scraping deposits, and it is less harmful to the engine

continued on page 104

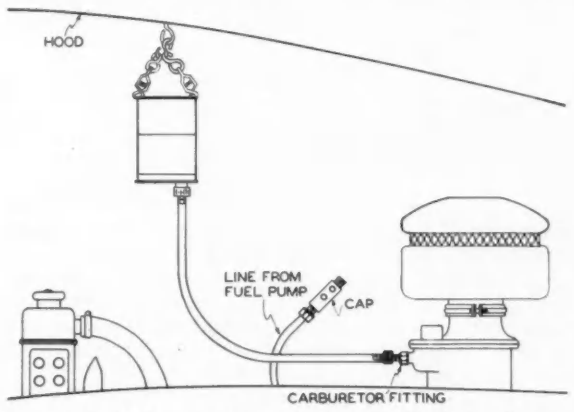


Fig. 1—This is the setup for application of PDQ Carbon Remover Process. Fluid comes packaged in 12-oz disposable container and is fed directly into carburetor.

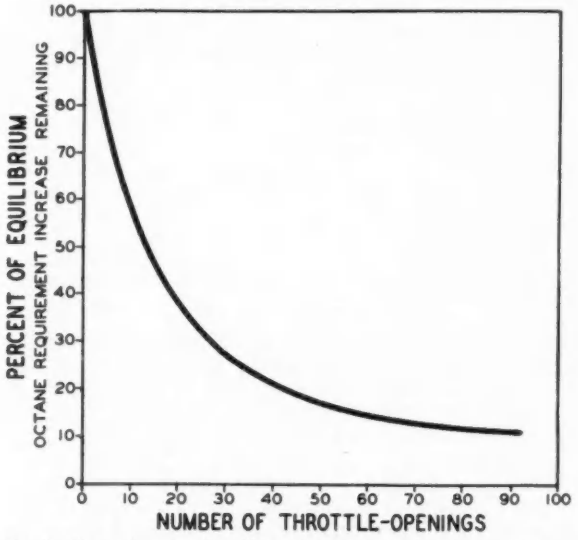


Fig. 3—Shown here is the effect of number of throttle openings on reducing octane requirement. (Data are average of results from four cars.) Complete deposit removal (as measured by reduction in octane requirement) is possible in 200 to 500 throttle openings.

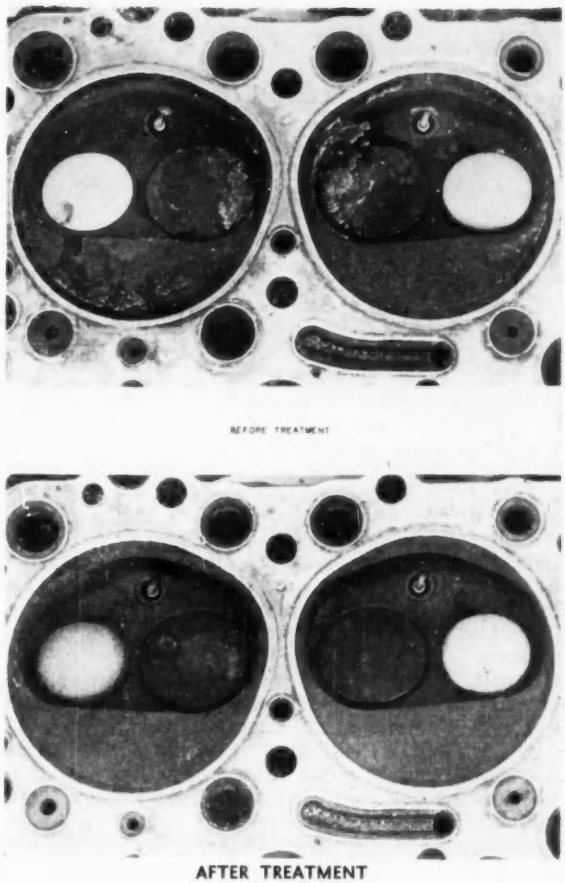


Fig. 2—Cylinder head of 1953 passenger car with 16,200 deposit miles before and after PDQ Carbon Remover process. Note deposits have been removed from end-gas sections where they caused knocking.

from the Sections

Northern California

Field Editor
C. F. Carey
Oct. 5

SOUTH BAY DIVISION, NORTHERN CALIFORNIA SECTION, GETS OFF TO SUPERCHARGED START — A crowd of over one hundred members and guests was present at the first technical meeting of the newly-organized South Bay Division of the Northern California Section held Oct. 5 in Los Altos, Calif. A social hour and dinner were followed by a presentation of the design and development of the McCulloch Supercharger. Through the use of motion pictures, slides, cut-aways, and two installed units, John W. Oehrli of McCulloch Motors Corp., Los Angeles, gave a splendid account of the operation and possibilities of his firm's unique supercharger.

Oehrli, a mechanical engineering graduate of Syracuse University (1924), was in charge of design and development at Lycoming Division, Aviation Mfg. Corp., until 1941. He has been associated with McCulloch Motors since 1944.

According to Oehrli, the McCulloch Supercharger has been developed and designed in such a way as to overcome at least three of the biggest objections to automotive superchargers: **high parasite drag at lower engine loads, high noise level,** and **excessive size.**

A pressure-controlled variable speed belt drive permits the supercharger to operate at relatively low speeds when a boost in manifold pressure is not required, thus reducing power losses. When desired, and even if engine speed is low, maximum pressure is almost instantly developed and maintained.

Oehrli explained that one reason for the small size and quietness of the McCulloch Supercharger was the unusual **planetary drive** employed to multiply input rpm. Instead of gears or rollers, the planets are balls about one in. in diameter. These balls wear well and have proved highly efficient.

A Corvette and a 1954 Ford equipped with McCulloch Superchargers were on hand outside to demonstrate two installations of this unit. With the hoods down, the superchargers were quiet enough to fool all but the most alert listener.

Field Editor
C. F. Carey
Nov. 2

NEITHER RAIN, NOR SNOW—NOR ELECTIONS— can keep SAE members from attending their appointed meetings. Or so, at least, it seemed Nov. 2 in Los Altos, Calif. Despite competition from all the major networks, nearly 70 members and guests were present at the second technical meeting of the South Bay Division, Northern California Section.

Chairman William J. Adams, Jr., conducted the meeting, which featured an outstanding address by Nicholas A. D'Arcy, an authority on hydraulic converters, who presented a side of the Torque converter picture with which SAE audiences might not be

familiar: the industrial applications of the Torque converter. This, he explained, was somewhat different from the automotive application, because industrial engines may be much larger (and smaller) than automobile engines, and can be expected to run at greater loads and for longer periods of time.

Although the converter itself is admittedly not as efficient as a gear transmission, it often allows the engine to be operated in a more efficient range. In addition, the converter **minimizes shock loads and torsional vibrations,** effecting tangible maintenance and down-time savings. Operator morale is likely to improve; at least, most operators seem to prefer it. Finally D'Arcy pointed out, a Torque converter will sometimes do a job that simply cannot be otherwise done.

D'Arcy demonstrated the principles of hydrodynamic transmission of power with slides and a model. The distinction between the fluid coupling and the Torque converter was demonstrated, and such questions as "When does a Torque converter become a fluid coupling?" and "What is a multistage converter?" were discussed.

Indiana

Field Editor
M. B. Emig
Oct. 21

ALLISON POWERAMA—PERMANENT MONUMENT TO MORE THAN 14,000 ALLISON PEOPLE. Allison Division of General Motors Corp. sponsored a dinner and a tour of the Allison Powerama. Allison produces jet engines, torque converters, transmissions and parts for diesel locomotives.

Indiana Section Chairman, W. H. McGlade, introduced special guests, Roy Adams of J. D. Adams Co., Ralph Teetor of Perfect Circle Corp. and also John Wilson of Allison Public Relations, who welcomed the 278 SAE members and guests.

The Powerama is a story of pioneering and progress in power. It is, for instance, the story of modern air power, beginning with the first reciprocating engine Allison made in 1932. It is also the story of more efficient and more economical manufacturing methods. Moreover, the Powerama is the story of power transmission with its automatic transmissions and Torqmatic Drives for trucks, tanks, ships, rail cars, oil wells and buses.

Most of the Powerama exhibits are animated and many of them "talk." The visitor can see a model test stand operate, putting a miniature turbo-prop engine and propeller through a simulation of tests Allison uses to prove their performance. Across the room he can push a lever and start a model jet plane on its flight, watch the flow of fuel, and hear an explanation of the vital importance of our fuel reserves. Or he can operate a tank or a Torqmatic transmission or a converter, and if you wonder how these power packages are made, that too is dramatized and explained.

Central Illinois

Field Editors
Y. M. Miller
E. E. Hanson
Oct. 29

AIR CLEANERS FROM "RAG OVER THE INLET" DAYS through water cleaners to present day oil bath types were discussed by W. W. Lowther of United Specialties Co. in his talk entitled, "Engine Protection."

Future advances of air cleaning efficiencies lie in the use of **after filtration,** according to Lowther. Cleaner units in a square or rectangular shape can provide more efficient space usage. These are the directions in which air cleaning engineering will advance.

Following Lowther's talk, E. E. Bryant of Nelson Muffler Corp. showed colored movies of a goose hunting trip to James Bay, Can. and Martin Willard, superintendent of Boy's Farm, told of the reasons for and development of this Springfield civic project.

Southern California

Field Editor
W. E. Achor
Oct. 11

AIRBRAKE FLAPS ARE USELESS BELOW SPEEDS OF 100 MILES PER HOUR, according to John S. Collman, assistant head of Gas Turbines Department, General Motors Research Laboratories, in discussing the paper "Pinwheels or Pistons." He went on to say that their wheel brakes were adequate. The brake drums are cast iron bonded onto cast aluminum.

British Columbia

Field Editor
J. B. Tompkins
Sept. 27

KEYS TO THE FUTURE OF THE DIESEL were presented in the paper, "The New Cummins Diesel PT Fuel System," as offered to members by C. J. Wilhite, manager, Northwest Region, Cummins Engine Co.

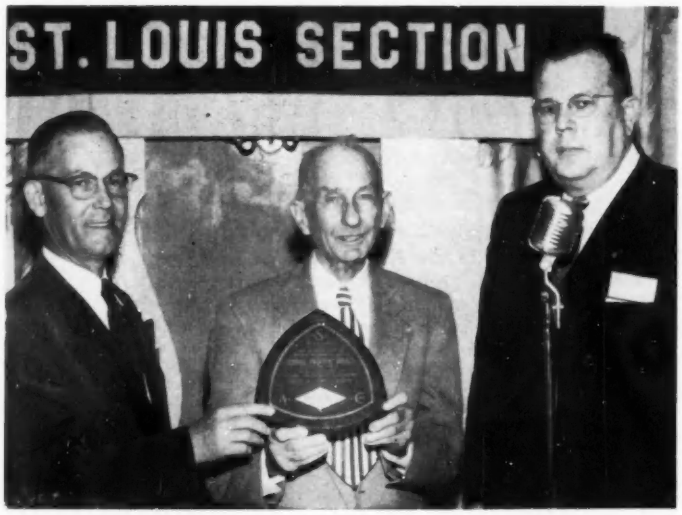
Because of the predominance of gasoline engines

Western Michigan Nov. 2

From Section Cameras

Talking to SAE members and their guests on the subject of noise and its reduction is Leino H. Billey, supervisor of muffler engineering, Donaldson Co., Inc.

St. Louis Oct. 12



Presenting A Special Plaque to George P. Dorris for his long and productive career in the automotive field and in the work of SAE is Monroe C. Alves, Past Chairman of St. Louis Section. Newly elected Chairman Harold C. Glidewell is at the right.

Southern California Oct. 11

Appearing As A Group at the Southern California Section Meeting are (left to right) O. F. Marsal, Chrysler Corp.; J. Hurd, Ford Motor Co.; Chairman Brent Malin, E. I. duPont De Nemours & Co.; Speaker J. S. Collman, assistant head of Gas Turbines Department, General Motors Research Laboratories; M. E. Russell, Ethyl Corp.; and D. A. Ringis, Chrysler Corp.

in the medium and heavy duty fields, Wilhite contends that diesel engines must keep pace with gasoline engine rotative speeds. Presenting a full report on Cummins' new simplified fuel system to the British Columbia Section in Vancouver and Alberta Group in Calgary, Wilhite keynoted the paper with two important observations: ". . . We believe that the ability to deliver fuel to the cylinder in a way to assure **rapid mixing with air and satisfactory combustion at high speeds** is one important key to the Diesel's future. We also believe that another key . . . lies in the **elimination of the complexities** of the Diesel fuel system. Not only is a lower cost system essential, but a system eliminating the need for specialists and special, expensive rebuild and testing equipment seems essential.

Philadelphia

Field Editor
G. T. Seng
Oct. 13

COMPRESSION RATIOS OF 10 TO 1 BY 1960 are indicated, and this, when coupled with **better engine-transmission combines** and **lower vehicle weight**, will result in fuel economy in the order of 54 mpg, according to Darl F. Caris, Research Laboratories Division, General Motors Corp.

Trends for the future in engine design, fuels and lubricants, and truck and bus operation were the topics discussed by a group of experts sitting as a panel at this meeting.

Design objectives for fuels and lubricants were summed up by Leonard Raymond, chief engineer, Automotive Division, Socony-Vacuum Oil Co., Inc. These objectives, as Raymond sees them, are:

1. Less knock, preignition and plug fouling.
2. Less wear.
3. Cleaner engines.
4. Less oil consumption.
5. Better fuel consumption.

In the future of truck and bus operation, Fred Hague, manager, Motor Transportation, Sun Oil Co., sees the need for improved cooling systems, and improved ignition systems (possibly a new concept). He also sees coming a nation wide look into the ever growing problem of legal restrictions.

Metropolitan

Field Editor
W. A. Kerkum
Oct. 7

THREE MAXIMUMS AND THREE MINIMUMS are required by truck operators for brake performance today, O. E. Johnson, vice president of Brake & Electric Sales Corp., told the SAE Metropolitan Transportation & Maintenance dinner-meeting. The **maximums** are **stopping ability, life** and **stability,** and the **minimums** are **brake drum failures, noise** and **maintenance expense.**

These requirements demand a braking system in balanced condition. Balanced brakes are maintained as the result of careful selection of replacement materials and components, tested and proven maintenance practices and the use of proper and adequate tools.

Johnson said that he tries to obtain 100 lb of pressure at the brake diaphragm and is usually not well satisfied with anything less than 90 lb at the rear of the vehicle. As the proper procedure to balance braking power in a combination, the speaker suggested trying to make each wheel brake handle its fair share of the gross load. Recent thinking indicates that all brakes on a vehicle should reach maximum power at the same time, rather than the trailer brakes coming in slightly ahead of the tractor brakes.

Cincinnati

Field Editor
O. L. Negangard
Oct. 25

THE FIRST TURBINE POWERED PASSENGER BUS, the Turbo-cruiser, and the much publicized XP-21 Firebird were discussed under the heading of Recent Developments in Automotive Turbines, presented by William Turunen. Turunen heads the Gas Turbines Department, General Motors Research Laboratories. He reported on the progress of General Motors Corp. in the Turbine Research and Development field. The paper was supplemented by color slides and a short movie, showing both vehicles in motion.

Pittsburgh

Field Editor
D. W. Gow
Nov. 2

A GIANT STEAM TURBINE TO DRIVE A 275,000 kw GENERATOR is under construction. Designed to operate at **5000 psi gage pressure** and **115 OF inlet steam temperature,** the double reheat turbine presented many problems for the metallurgist, stated Norman L. Mochel, manager of metallurgical engineering at Westinghouse Electric Corp. and president of the American Society of Testing Materials. Mochel spoke at a joint meeting of SAE Pittsburgh Section and ASTM Pittsburgh District.

Mochel's talk covered the past 50 years of steam

From Section Cameras

Northwest Oct. 8

Speaking on Boeing Airplane Co.'s Model 707 Jet Liner at Northwest Section meeting is Maynard L. Pennell, chief project engineer-Aircraft, Boeing Airplane Co.

Canadian Sept. 13

During Presentation of the Past Chairman's Certificate are shown (left to right) D. C. Gaskin, a Past Chairman; A. A. Scarlett, immediate Past Chairman and recipient of the certificate; W. S. Cowell, an SAE Councillor; and R. J. Renwick, Section Chairman.

Twin City Nov. 9

New Member L. O. Nelson is presented his membership pin by Membership Chairman Al Preston. Also standing (left to right) are H. W. Carlson and E. A. Hansen. Seated are Don Van Orman, Meetings Chairman; John Thomas, director of engineering, Thomas Hydraulic Speed Controls, Inc., speaker on "Hydraulic Variable Speed Couplings and Their Control of Standard and Automatic Transmissions;" and Les Foster, Section Vice-Chairman.

generated electrical power in this country. Starting with huge reciprocating engines capable of producing only a few thousand kw, great strides have been made in bringing about the present day equipment. Many complicated metallurgical problems had to be solved and ingenious casting and forging methods developed during these years. Looking into the future, Mochel stated that the metallurgist and materials expert will most likely be challenged by even higher operating temperatures and pressures.

Washington

Field Editor
R. J. Auburn
Oct. 19

A BIG SPLASH occurred when The Corps of Engineers' Research and Development Laboratories at Fort Belvoir, Virginia, were hosts to the Washington, Baltimore, and Richmond Sections in a tour of ERDL facilities and demonstrations of latest Engineer Equipment. The splash came when heavy ponton bridge sections were launched on the Ponton Basin in a demonstration of floating bridging operations, while various types of boats scurried about the basin—ranging from the three man electric reconnaissance boat, to the heavy freight raft which is made up of pontons with standard steel treads, and totes a **62 ton load** with power supplied by a 27 ft twin-screw tug.

The group had a first-hand look at results of standardization efforts of the SAE Construction and Industrial Machinery Technical Committee in developing **interchangeable tractor attachments** and in drastically reducing the number of parts for industrial engines used by the Corps of Engineers.

Salt Lake

Field Editor
C. W. Dunbar
Nov. 2

"FOUR TON PAYLOAD GAINS WITHOUT EXTRA WEIGHT OR PRICE and without exceeding chassis, axle or tire ratings or legal axle loads are possible on standard tractor-semitrailer combinations." So stated Merrill C. Horine in presenting his paper, "More Payload Through Better Weight Distribution," before the November meeting.

Horine, consulting engineer, Research Division, Mack Mfg. Corp., explained how these gains, far beyond the fondest hopes of light-weight enthusiasts, can be realized by a few simple changes in fifth wheel and semitrailer axle location.

Ideal distribution, in the more difficult problem presented by the tractor-semitrailer combination, requires that the kingpin be so located in reference to wheelbase that the weight be proportionately distributed to the axle capacities. **The distribution of the gross load of the semitrailer between fifth wheel and its axle depends upon the relation of the center of gravity of the load to the distance from the kingpin to the axle or tandem center.**

Load distribution offers, above all other factors heretofore considered, the greatest opportunity for increase in legal payload without sacrifice of other desirable characteristics.

Williamsport

Field Editor
B. L. Sharon
Oct. 4

THE GAS TURBINE WILL NOT REPLACE PISTON ENGINES in the nation's motor cars and other vehicles until the problems of **fuel economy, delayed acceleration,** and **lack of engine breaking,** together with the **need for costly high temperature alloys** are solved.

The gas turbine's future for powering automobiles, trucks, or buses depends on developments still in their early stages, stated John S. Collman, assistant head of Gas Turbines Department, General Motors Research Laboratories, before 85 members and guests of the Williamsport Group.

Collman stated the advantages of the gas turbine over automotive or diesel engines to be:

a. Better weight-to-power ratio.
b. Produces maximum torque at stall.
c. Operates on relatively low grade fuels.
d. No reciprocating parts.
e. Almost completely free of vibration.
f. Applies power so smoothly that maximum traction can be maintained during acceleration.

Field Editor
B. L. Sharon
Nov. 1

UNITED CHROMIUM INVESTIGATIONS under U. S. Air Force contract indicate that:

(1) the fatigue limit of unbaked chromium plated steel is higher the finer the crack pattern of the chrome deposit; (2) the lowering of the fatigue limit of steel after chromium plating is not due to hydrogen embrittlement; (3) baking after chromium plating in the range of 300-400F lowered the fatigue limit, while baking at temperatures of 700-800F approached the non plated fatigue limit.

From Section Cameras

Northern California Oct. 5

The Successful First Meeting of South Bay Division had as its speaker John W. Oehrli of McCulloch Motors Corp.

Oct. 5

Close Attention Is Given to the cut-away of McCulloch Supercharger by members of the newly-formed South Bay Division.

Nov. 2

Investigating Model Fluid Couplings are (left to right) F. L. Jarrett; guest speaker N. A. D'Arcy; and South Bay Division Chairman Bill Adams.

The lowering of the fatigue limit in chrome plated high strength steel is due to **residual tensile stresses** in the chrome plate. Walter S. Cibulskis, chief engineer, United Chromium, Inc. presented this information to members.

Northwest

Field Editor
S. J. McTaggart
Oct. 8

ASSUMING $4,000,000 FOR A JET TRANSPORT and $1,500,000 for a four-engine propeller driven transport, the Jet, flying twice as fast and hauling twice the payload, will operate at approximately 10¢ per ton mile as compared with 17¢ per ton mile for the propeller driven plane.

Increased take-off power, faster rates of climb and descent, and **simplicity of controls** make the Boeing Airplane Co.'s Model 707 Jet Transport safer from a performance standpoint. The Jet Transport is also cheaper, safer and faster than four-engine propeller driven airplanes operating in the 500 to 3,000 mile range, stated Maynard L. Pennell, chief project engineer, Aircraft, Boeing Airplane Co.

In discussion it was pointed out that jet runway lengths of 7,000 ft. for coast to coast range flights and 5,000 ft. for Seattle to Denver range flights are presently available at most major airports. Jet thrust deflectors are being developed to utilize reversed thrust as a braking force to reduce landing runway length requirements. Because they have had less military support, Turbo propeller engines are not at the same stage of development as Jets.

Mohawk-Hudson

Field Editor
J. B. James
Oct. 12

THE WORLD'S FIRST TURBO-JET POWERED FLIGHT by the Germans in a Heinkel 178 in 1939 was indicative of their substantial, early jet engine progress. These early developments included a test chamber to simulate altitudes to 40,000 ft, as presented by L. F. Smith of the General Electric Co.

Smith was assigned by the U. S. Navy to manage continuation of German work on the Heinkel 109-011 turbo-jet at their Stuttgart Works after World War II. Nine of the engines were then completed for evaluation. A feature of interest in the engine was the **mixed flow compression stage** which was used **in combination with four axial stages.**

A novel feature of the combustion chamber was the multiple mixing fingers which "interlaced" through the chamber. If individual fingers overheated in development, they were merely chopped out.

The engine employed **pin-mounted, hollow, air-cooled turbine blades,** which could be manufactured of low alloy material and at low cost. This was in anticipation of their urgent need for quantity production for short range interceptors.

Detroit

Field Editor
G. F. Gass, Jr.
Oct. 19

BUILD A PLANT WITHIN A PLANT and have an assembled product as complex as the Hydra-Matic transmission come off the assembly line in twelve weeks time! Impossible? No! This seemingly impossible task was undertaken and completed in a plant which initially had been used to produce military airplanes.

The Detroit Transmission Division of General Motors Corp. played host to the Junior Membership of the Detroit Section. A tour of the Hydra-Matic transmission production and assembly plant at Willow Run, Mich., was the order of the day and the Junior Membership displayed its enthusiasm by turning out enmasse; in numbers—250.

Groups of 10, led by capable guides, permeated the plant, which uses about ½ of the available 4,400,000 sq ft of floor space, to observe the activities that were taking place. The myriad of details concerned with the assembly of the Hydra-Matic, from bending the torus blade tabs through cutting the gears to the final dynamometer test at the end of the assembly line, were laid open for inspection and the members gratefully availed themselves of the opportunity.

The efforts of Activities Chairman, Bill Coleman, were fully realized. The trip was a huge success.

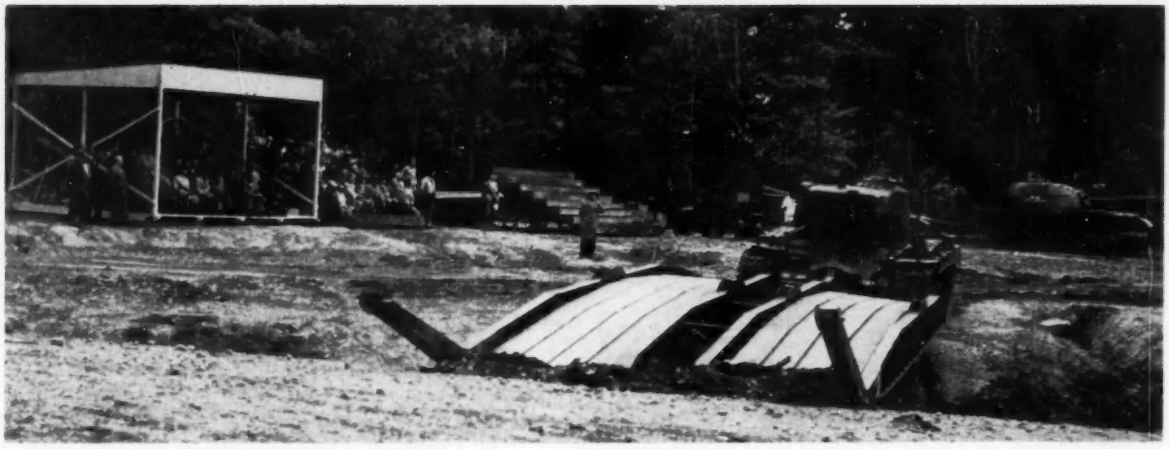
Field Editor
G. F. Gass, Jr.
Nov. 1

INTERESTING FIELD TRIP, HILARIOUS DINNER TALK, AND EXTREMELY INFORMATIVE TECHNICAL PAPER were organized by Junior Members into the Nov. 1 meeting.

Kenneth Gordon, recipient of the first L. Ray Buckendale award and a Junior SAE member, presented the technical paper on "Design, Evaluation, and Selection of Heavy-Duty Rear Axles."

"The Psychology of Laughter" was the topic of dinner speaker Walter Benson, assistant to the president of American Trucking Association. He tried to prove that all laughter is an expectation

Washington Oct. 19



An Experimental Assault Bridge is launched across a short gap by a standard Army tank during a visit of SAE members to the Corps of Engineers' Research and Development Laboratories, Fort Belvoir, Va.

Southern New England Oct. 12

Potentialities of the Boeing 707 Jet Liner are discussed by (left to right) Phil Doran, chief, Airlines Engineering, United Aircraft Service Corp.; Speaker Kenneth C. Gordon, manager of Commercial Sales, Boeing Airplane Co.; and Harry Nystrom, American Bosch Arma Corp., Section Chairman.

Indiana Oct. 21

Witnessing a Demonstration, by an Allison representative, of the operation of a test cell and engine at Allison Powerama is part of the large visiting crowd of SAE members and guests. The planes suspended from the ceiling are models of those supplied with power by Allison.

that ends in nothingness or springs from incongruity.

The afternoon was spent in a field trip to the dynamometer test laboratories of the Timken-Detroit Axle Division, Rockwell Spring & Axle Co. The highlight of the trip was the Alden Indoor Proving Ground. This 450 hp input, triple dynamometer rear-axle test set-up is unique in that it loads, unloads, accelerates and decelerates according to predetermined rates imposed on a tape recorder which directs the actions of the electronically controlled dynamometers. Once the dynamometer operator records the cycle through which the axle is to be tested, the tape recorder repeats the cycle until the test is terminated. It is possible, on this installation, to cycle on axle to a speed equivalent to 60 mph with a load equivalent to an 80,000 lb truck.

Texas Gulf Coast

Field Editor
G. W. Putney
Oct. 18

50% MORE ENGINE LIFE IN ON-HIGHWAY OPERATIONS and approximately 47.5% more engine life on off-highway operations is offered by the torque converter drive. This is due to 12 to 13.7% **fewer engine revolutions per mile** of the converter drive as compared to the mechanical drive. Also, the converter had 9.1 to 13.2% **better fuel mileage** than the respective mechanical drive.

The hydraulic transmission in one form or another looks like the coming transmission in many groups of commercial vehicles of the future. This is what R. M. Schaefer, manager, Transmission Department, Allison Division, General Motors Corp., told members.

Western Michigan

Field Editor
W. C. Chaffee
Nov. 2

"NOISE IS SOUND OUT OF PLACE and is an indication of bad engineering," said Leino H. Billey, supervisor of muffler engineering at the Donaldson Co., Inc. Billey spent 20 years as a teacher before entering industry 10 years ago and is an authority on the subject of noise and its reduction through the design of mufflers.

In attenuating noise, the two possibilities are to absorb sound and set up interference. Too frequently the engineer amplifies the noise instead of attenuating it. Billey explained some of the tricks in designing mufflers for heavy duty equipment and made a plea to the designers of this equipment to allow at least six times the displacement of the engine for a good muffler.

Past Chairman William Kennedy was presented a certificate in recognition of his work by Chairman Tom Reeves and an interesting movie on the Atomic Submarine by General Electric Co. was shown.

St. Louis

Field Editor
E. S. Kropf
Oct. 12

PRESENTATION OF A SPECIAL PLAQUE to George P. Dorris, pioneer automobile manufacturer of St. Louis in recognition of his long and useful career in the automotive field, marked this first fall meeting.

Joining SAE in New York in 1910, and then transferring his membership to the St. Louis Section, Dorris at 80 is the oldest active member of the St. Louis group. Dorris manufactured motor cars in St. Louis from 1898 until 1926, producing almost every part in his own plants. Along with A. L. Dyke, he produced the first American-made float feed carburetor, now in the Smithsonian Institute.

During his career, Dorris has been awarded 15 patents on basic automobile inventions. Auto historians still consider the Dorris a fine machine. It won the 1911 St. Louis-Kansas City cross country run, in which other entries ranged from Fords to Cadillacs. Among its unparalleled feats was a string of economy records for its size and weight in the 1919, 1920, 1921 runs over the Los Angeles-Yosemite course.

Following the presentation of the plaque, Dorris and his son Duncan showed slides of many of his early cars and views of his manufacturing plant and early inventions.

The meeting was officially opened with the annual presentation of the Chairman's gavel by members of the Parks College Student Branch. Faculty advisor Frank Myers and Student Chairman Carol Carbaugh made the presentation to the Section's new Chairman Harold C. Glidewell.

Kansas City

Field Editor
A. M. Ernat
Oct. 12

APPROXIMATELY 42 HOURS LABOR PER VEHICLE PER YEAR is required on the average to perform all of the established routine service work, including **gassing, polishing** twice a year, **washing** every two weeks, and **cleaning the engine** annually. It is interesting to note that the appearance items require about 13 hours and the gassing operations about 11 hours annually. The remaining 18 labor hours of preventative maintenance service work represents a very small part of the operating ex-

pense, but pays off in reduced repairs and vehicle off-time.

The need for good servicing of vehicles is perhaps one point of view that is shared wholeheartedly by both the manufacturer and the user. This is what R. C. Hugo, Motor Vehicle Methods supervisor, Southwestern Bell Telephone Co., told members.

Without preventative maintenance, the resultant premature failures and early vehicle replacement are costly to the owner and are apt to falsely reflect on the manufacturer to produce a satisfactory unit.

Southern New England

Field Editor
A. D. Nichols
Nov. 3

EASY STARTING CHARACTERISTICS AND THE LOW MAINTENANCE FACTOR of the small two cycle engine are the principal causes for the popularity of this type engine. Its easy starting characteristics regardless of the ambient temperatures are possible because **no oil is maintained in the crankcase** and its low maintenance factor is due to the **minimum use of moving parts.** This is the opinion expressed by Sheldon D. Pollow, chief engineer of Power Products Corp.

The use of ballbearings on the crankshaft of the small two cycle engine resulted in several distinct advantages. First, the shaft was accurately located so it ran on a true center even under varying loads, allowing the shaft seals to maintain constant contact with the rotating shaft. This resulted in maintaining a consistent pressurized fuel-air ratio which eliminated the necessity of readjusting the carburetor setting. Second, it was not necessary to provide as much oil in the gasoline mixture for lubricating purposes. Third, the life, reliability, and performance of the engine was increased by reducing the frictional horse power requirements.

Field Editor
A. D. Nichols
Oct. 12

550 TO 575 mph CRUISING SPEED AT 35–45,000 ft, with the ability to carry 80–100 passengers non-stop across the Atlantic Ocean, signifies the Boeing 707 Jet liner. The plane carries roughly an equivalent of two freight cars of fuel and its weight is about 200,000 lb.

Economy, safety, reliability, long term usefulness and **performance** were the main objectives in the design of the Boeing 707, which will be ready for airline use sometime in the summer of 1958. Boeing's manager of commercial sales, Kenneth C. Gordon, made this statement at Bradley Field.

Preliminary studies showed that the logical number of engines would be four and that the airplane should be capable of speed up to Mach 1.

Gordon said that the Pratt & Whitney engines compiled a remarkable record in the 707. There were only two minor complaints in the first 50 hr of operation and only one of these could be directly attributed to the engines. Previously, 40–50% of maintenance man hours went into engine repair.

Chicago

Field Editor
J. K. Nemeth
Oct. 12

AN AUTOMOBILE STYLIST MUST BE A SCULPTOR, possess an aesthetic sense that enables him to visualize and create in three dimensions, be a complete master of tools of styling craft, have an understanding of product development, production methods, and most important, he must have a keen sense of interpreting consumer psychology. Duncan McRae, chief stylist, Kaiser Motors Corp. and Willys Motors, Inc., gave this description in reviewing background and requirements of the stylist.

Ken Coppock, assistant chief engineer of Fisher Body Division, General Motors Corp., stated that, through the years, the automobile **stylist** has expanded and specialized to the point where today, he **sets the shape of the car before the chassis and body engineers enter the design picture.**

Montreal

Field Editor
P. E. Faulkner
Oct. 22

A MARRIAGE BETWEEN TWO PHILOSOPHIES IS NECESSARY for the ideal automatic flight control system; **the Military,** one of ever increasing dynamic force; **the Commercial,** one of ever increasing safety reliability and maintainability. This marriage is now being accomplished, according to James B. Treacy, assistant sales manager, Automatic Flight Control, Eclipse-Pioneer Division, Bendix Aviation Corp., who gave a paper on "Automatic Flight Control."

The automatic flight control systems of today are much more complex and capable than ever before, yet the reliability and safety features engineered into them has resulted in greatly increased operational hours between overhauls and reduced in-flight malfunctions.

Over 100 members were present at this first meeting of the 1954–55 season and the chairman's gavel was delivered from last year's chairman, Louis F. Vauthier, Dominion Rubber Co., over to Harold W. Royl, Sperry Gyroscope Co. of Canada, Ltd., the new chairman.

About SAE Members

continued from page 72

ROBERT G. HOCH, formerly manager of Minneapolis-Honeywell Regulator Co.'s aeronautical office in Fort Worth, Texas, has been appointed manager of the New York region. This region has responsibility for sales and service of the firm's aeronautical products over an area extending from the New England states as far south as Philadelphia. Headquarters are in Union, N. J.

Hoch

Lybeck

ROBERT F. LYBECK has joined the faculty of the Graduate Division of the School of Business, Northeastern University, where he will offer a course on Managerial Control Distribution. He retired in December, 1953 from Esso Sandard Oil Co. after 33 years of service. At the time of his retirement, he was manager of aviation sales in New England. Lybeck was an SAE Councilor in 1951–52.

A. vanderZee, vice president, Chrysler Corp., was elected chairman of the Inter-Industry Highway Safety Committee at a recent meeting of the committee in Detroit. In accepting the chairmanship, vanderZee said, "Mile for mile automobile travel today is nearly twice as safe as nine years ago with an increase of 87% in motor vehicle registrations for the same period."

D. M. FINCH, associate professor of electrical engineering at the University of California, was one of ten members of the Illuminating Engineering Society, to be awarded the Fellow emblem. These elections to the highest professional membership grade in the Society represent outstanding technical competence.

J. H. CARMICHAEL, president of Capital Airlines, was honored by the Sixth Annual Virginia World Trade Conference when a scroll was presented to the company. The scroll cited the company's purchase of forty Vickers Viscount turboprop airplanes which, the citation said, "furthers the aims

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Steel automobile bodies that are chemically cleaned and phosphate coated in an integrated Spray Granodizing process exhibit these advantages:

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Substantial Price Reductions

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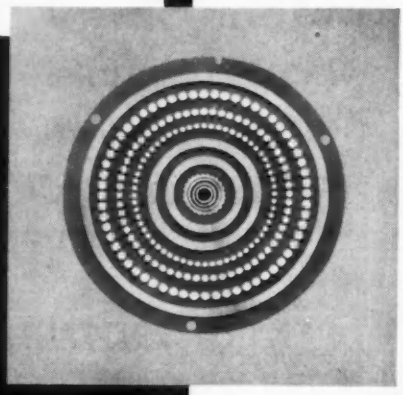

Increased production of Mycalex 410 Telemetering Commutators now brings new savings to the user. Universally accepted as the finest commutator plate in the field, this precision-built unit injection-molded of Mycalex 410 glass-bonded mica insulation assures permanent dimensional stability — provides a tenacious bond to the metal inserts.

Important MYCALEX features—

- no dimensional change with age, humidity or temperature
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- high speed brush means no "bounce", no "hash", provides square wave switching.

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SINCE 1919 MYCALEX THE INSULATOR

and objectives to which this conference is dedicated."

The citation stated that "one of the cardinal purposes of the Virginia World Trade Conference is to promote international trade, and Capital Airlines, a Virginia Corporation, has made a substantial contribution to international trade by having placed large orders for the import of British Vickers Viscount airliners."

WILFRED R. FOX, formerly promotion and research manager for the Rogers Publishing Co. in Detroit, has formed W. R. Fox, Inc. in Owosso, Mich. as a service of building convention displays for Michigan manufacturers. He is president of the new company.

MILTON R. VIPOND is now president and owner of the Berea-Vipond Co. in Berea, Ohio, formed to represent manufacturers and serve in the field of sales engineering. He formerly was vice-president of the Ohio Piston Co. in Cleveland.

DOGAN H. ARTHUR has been appointed aircraft sales manager of Aeroquip Corp. in Jackson, Mich. He was formerly assistant aircraft sales manager. In his new position, Arthur will be responsible for sales to aircraft customers of Aeroquip Corp. and Aero-Coupling Corp., Burbank, Calif., Aeroquip's West Coast subsidiary.

Arthur

Brownlee

JAMES C. BROWNLEE has been appointed to the newly-created position of Regional Service Manager for the Toronto region by Chrysler Corp. of Canada, Ltd. Previous to this assignment, Brownlee served as parts and service representative.

J. S. DAVIS, former director of public relations of Borg-Warner Corp., heads the new Johnson-Davis Co. representing manufacturers in the sale of industrial products as president. **C. S. DAVIS, JR.** has been elected a vice president. Offices of the new company are at 952 North Michigan Avenue, Chicago.

CHARLES B. EISENHAUER, formerly manufacturing advisor to the president of Houdaille-Hershey Corp., Detroit, has taken the position of vice-president and general manager of Ultrasonic Corp., Cambridge, Mass.

A. F. MILBRATH, chief engineer and vice president of Wisconsin Motor Corp., Milwaukee, retired from active duty after 45 years of continuous service with this world's leading manufacturer of heavy-duty air-cooled engines.

Milbrath has long been recognized as one of the nation's leading designers of internal combustion engines. He has been a member of the SAE since 1910, was a member of the Standards Committee for a number of years and in 1926 was named chairman of the committee.

HOWARD E. GEER has taken the position of product analyst in the Herbrand Division, Bingham Herbrand Corp., Fremont, Ohio. He was formerly junior engineer with Electric Auto-Lite Co., Toledo, Ohio.

MURRAY F. CROSSETTE, JR., who has been a field manager on the Hawaiian Islands for Ford Motor Co., is now field warranty and policy representative with the Ford Division Technical Service Laboratory in Dearborn, Mich.

JULES L. DUSSOURD is now associated with Airesearch Mfg. Co. in Los Angeles as engineering specialist. With Consolidated Vultee Aircraft Corp., he had been senior propulsion engineer.

F. E. CARROLL, JR., chief engineer, United Aircraft Products, Inc. was the speaker at the Dayton meeting of the Institute of the Aeronautical Sciences. He spoke on the general subject of supersonic accessories which are being developed and manufactured by UAP.

TURNER A. DUNCAN has been elected executive vice president, general manager, and treasurer of the Turner Mfg. Co. in Statesville, N. C. He has also been elected a member of the board of directors of the Turner Mfg. Co. and the Precision Gear and Machine Co., a wholly owned subsidiary in Charlotte, N. C. He has been serving as vice president of ACF-Brill Motors Co., Philadelphia, Pa.

ROBERT A. HEATH has been appointed chief engineer on the Walker Mfg. Co.'s line of exhaust silencers. Heath, who has been a member of the Walker-Michigan Division Engineering staff for four years, will be in charge

WOULD YOU LIKE TO HELP DEVELOP . . .

Nuclear propulsion?

If you are an engineer or scientist who wants to get in early on the age of nuclear propulsion, this may be exactly what you have been looking for.

On this project, you will be working on one of the most challenging problems of today — the development of a nuclear-powered aircraft engine. You will be engaged in a creative-type of engineering where there will be every chance to gain professional recognition.

You will work within the continental United States for Pratt & Whitney Aircraft — world's foremost designer and builder of aircraft engines. You will have all the advantages of this progressive organization — the advancement opportunities — the chance to build a sound, well-rewarded career.

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PRATT & WHITNEY AIRCRAFT
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STOW flexible shafting
ON THE JOB

pumping GAS on a tractor-trailer

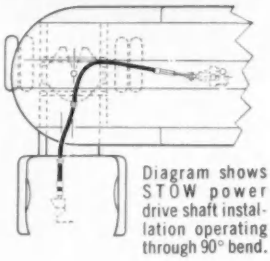

Diagram shows STOW power drive shaft installation operating through 90° bend.

STOW Flexible Shafts have effectively solved power take-off problems on both trucks and tractor-trailers. Large shafts, such as the 1¼" pictured above which transmits up to 10 H.P., have proven their ability on power take-off applications more efficiently and with more trouble-free service... **to operate pumps** for petroleum, milk and other liquids; **to operate conveyors** for grain, coal; **to operate compressors** on refrigeration trucks.

Why not put Stow to work on your power drive problems? Stow Engineers are always at your service.

For complete engineering data and illustrations on STOW Flexible Shafting—Write today for FREE Bulletin 525.

Write today for Bulletin 542 and complete data on Power Take-Off drives.

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234 SHEAR ST., BINGHAMTON, N.Y.

of all engineering on both original equipment and replacement mufflers including engineering contacts with the car factories.

THOMAS B. CHACE was elected to the post of director of the Dole Valve Co., Chicago, at a meeting of company stockholders. He has served as vice president since 1941.

ROBERT L. McKINNON is now serving in Tulsa, Okla. as associate engineer for Douglas Aircraft Corp. He had been associated with the Santa Monica, Calif. plant in the same position.

RICHARD DOUGLAS LE CLAIR has changed his position from senior designer to senior management specialist with the A. O. Smith Corp. in Milwaukee, Wis.

WILLIAM PAUL BARDET has become sales manager for Pioneer Motor Bearing Co. of San Francisco. He had been employed in the sales department of that company.

C. A. KURRASH has been made plant product engineer of the Eaton Mfg. Co. Valve Division at Battle Creek, Mich. He was formerly chief draftsman at the Eaton Detroit plant.

LESLIE W. HOBERECHT has joined Allison Division of General Motors Corp. in Indianapolis as a senior project engineer in the Turbo Jet Controls Group. He had served in the same position with Cadillac Motor Car Division of GMC in Cleveland.

CLIFFORD M. RIGSBEE, former manager, Commercial Service, RCA Service Co., moved to RCA, Product Planning as administrator, Consumer Product Planning, October 1. Rigsbee was Chairman of the SAE Indiana Section 1944-45.

C. KENNETH KUMMERLOWE, who had been experimental engineer with the Four Wheel Drive Auto Co. of Clintonville, Wis., is at present chief, Transport Vehicle Branch, Yuma Test Station in Yuma, Arizona. He served as Treasurer of the Baltimore Section in 1951–52.

ROBERT S. KINSEY is associated with Reaction Motors, Inc. of Rockaway, N. J. as assistant to the president. He was previously manager of industrial engineering for Wright Aeronautical Division of Curtiss-Wright Corp. in Wood-Ridge, N. J.

RAYMOND A. CHURCH has taken the position of product engineer with the Felt Products Mfg. Co. of Chicago. He had served as project engineer for Victor Mfg. and Gasket Co. in Chicago.

FRANCIS T. BRADLEY, who had been consulting engineer and director of the Citrus Co. of British Honduras, is at present consulting engineer for Century Geophysical Corp. of Tulsa, Okla.

GERALD DAVID OLSON has joined Webster Electric Co., Racine, Wis. as project engineer in the Oil Hydraulics Group, after serving in the U.S. Navy as supervisor of shipbuilding in Bath, Maine.

Students Enter Industry

ROBERT C. MELLIN (Purdue '52) has rejoined the Research Laboratories Division of General Motors Corp. in Detroit, from which he has had a military leave of absence.

RALPH D. STEELE (Parks College '54) has joined the Arnold Research Organization in Tullahoma, Tennessee as an engineer.

CHESTER G. GOOD, JR. (General Motors Institute '54) is now associated with Allison Division, General Motors Corp. in Indianapolis in the sales engineering department.

LYLE M. LIDIKAY (Purdue University '54) is associated with the Pontiac Motor Division of General Motors Corp. in Pontiac, Michigan, as an engineer in the Power Development Section.

JOHN S. YOUNG (Stevens Institute of Technology '52) is now working with Caterpillar Tractor Co. in Peoria, Ill. as research engineer, Applied Mechanics Division.

EARL J. KLIEMAN (Oregon State '54) is an assistant engineer with the Allis-Chalmers Mfg. Co. in Milwaukee, Wisconsin.

Please turn page

MESSAGE TO AN ENGINEER THINKING ABOUT THE FUTURE— HIS FUTURE

Take a few moments now to review the progress of your career. Does your present position offer you a future that fully utilizes your creative abilities?

Compare your present assignment with the diversified, stimulating pursuits that increase the inventive challenge of Fairchild's team of qualified engineers. These men are working on engineering advances for the famous C-119 Flying Boxcar and the soon-to-be-produced C-123 Assault Transport. More than that, they are developing tomorrow's jet fighters . . . special reconnaisance aircraft . . . jet bombers and transports. The men at Fairchild know that *planned* project diversification keeps them in the forefront of the field of aerodynamics.

Gracious country living only minutes away from urban Baltimore or Washington . . . paid pension plan . . . an excellent salary with paid vacations . . . ideal working environment . . . generous health, hospitalization and life insurance . . . and the many other benefits of a progressive company add to the pleasure of working with Fairchild.

You'll be investing wisely in a secure future if you take time today to write to Walter Tydon, Chief Engineer, outlining your qualifications. Your correspondence will be kept in strict confidence, of course.

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FAIRCHILD
Aircraft Division
HAGERSTOWN, MARYLAND

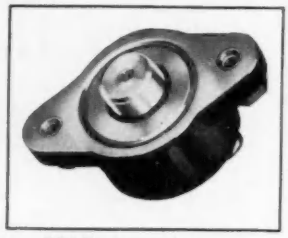
PROTECTION PERFORMANCE Assured

HERE ARE THE CIRCUIT BREAKERS TO USE FOR

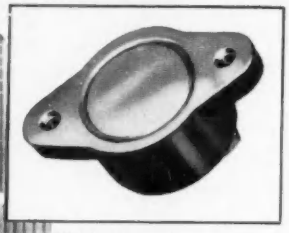
Permanent Bus Protection

KLIXON

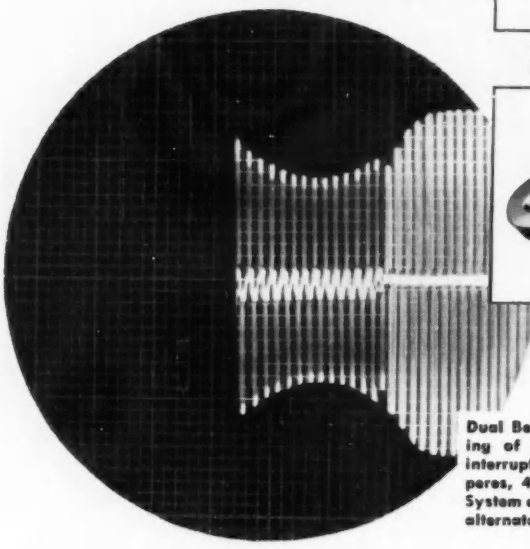
PDLM and PDLA



PDLM manual reset, Ratings: 35 to 150 amps.



PDLA automatic reset, Ratings: 35 to 150 amps.



Dual Beam Oscillograph recording of a PDLM — 70 amps., interrupting a fault of 3600 amperes, 400 CPS, 120 Volts A.C. System comprised of 4 — 40KVA alternators.

These *precision* circuit breakers will clear the circuit, handle the fault current and provide permanent bus protection. In addition, they give you these outstanding advantages.

- Simplicity — only one moving part, the Spencer Disc. Retains original operating characteristics over years of service.
- Completely sealed and truly explosion-proof.
- Exceptionally high shock and vibration resistance.
- Individually calibrated to limits of 115 to 125% . . . ½ as wide as AN limits (115-138%).

Write for data on these and other Klixon Aircraft Circuit Breakers.

KLIXON

METALS & CONTROLS CORPORATION
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Students Enter Industry

continued

SEYMOUR ROTH (University of California '54) has joined the Pratt & Whitney Aircraft Co. as an experimental test engineer.

WILLIAM L. GILES (University of Wisconsin '54) is now a fleet engineer for the Steffke Freight Co. in Wausau, Wisconsin.

THOMAS J. CRIBBS (Notre Dame '53) has taken a position with Ford Motor Co. as an engine design detailer.

JAMES MADISON MATHIS (California State Polytechnic College '54) is now a mechanical engineer for the Westinghouse Electric Corp., A.G.T. Division, Kansas City, Missouri.

ROBERT ARONSTEIN (California State Polytechnic College '54) is now a graduate student associated with the Westinghouse Electric Corp. in East Pittsburgh, Pennsylvania.

CHARLES W. FERGUSON (Indiana Technical College '51) has joined Olin Industries, Inc. of East Alton, Ill. as a metals research engineer.

HERBERT WILLIAM GILBERT (University of Wyoming '52, Chrysler Institute of Engineering '54) is now an assistant project engineer with the Engineering Division of the Chrysler Corp. in Detroit, Michigan.

DONALD J. BREWSTER (Oregon State '52) is now a design engineer for North American Aviation, Inc., at Downey, California.

FRANK P. GROSS, JR. (Purdue University '54) is associated with the Shell Oil Company in Wood River, Illinois, as a research engineer.

ISAM S. NIMR (Utah State College '54) is an instructor in the mechanical-automotive department of the Broome County Technical Institute at Binghamton, New York.

DON ALLAN MEYER (Purdue University '51) is now a thermal design engineer with the Kewanee-Ross Corporation of Buffalo, New York.

continued from page 79

being studied concerns machining tolerances, error allowances, and fitting clearances. Data from many users are being studied to determine tendencies of current manufacturing and inspection. The type of gaging required for part inspection is also being listed and studied. Since the Subcommittee will make decisions based on these data, the more it receives the more conclusive its decisions will be.

Appropriate error allowances for broached internal splines are being studied because the allowances in the 1950 issue of the Standard are greater than needed for broached parts. Some studies are being made of the tolerances of Class 4 of the Gear Inspection Standard, since they are more in line for broached parts than those in Class 3 which are now used.

CSMA Offers Strips For Brake Fluid Tests

THE metal coupons required for the corrosion tests outlined in the SAE Standard on Hydraulic Brake Fluid (SAE 70R) will soon be obtainable from the Chemical Specialties Manufacturers Association. The SAE Hydraulic Brake Fluids Subcommittee has received this news from the CSMA.

The strips will be available in lots of 18 strips $3\frac{1}{2} \times \frac{1}{2} \times \frac{1}{8}$ in., three strips each of tinned iron, SAE 111 cast iron, SAE 1010 steel, SAE 24 aluminum, SAE 70B brass, and SAE 71 copper. (It takes one lot to carry out the group of tests stipulated in the Standard.) CSMA expects to sell the lots at about $12 each.

Strips of each metal will be available also in multiples of 50. Prices are estimated now at from $53 per 100 pieces for the steel coupons to $100 per 100 pieces for the cast iron coupons.

Strips are numbered, highly polished, and have a hole drilled at the top.

Order blanks for the coupons were distributed with CSMA Bulletin No. 133-54, which is available from the Chemical Specialties Manufacturers Association, 50 East 41 Street, New York 17, N. Y.

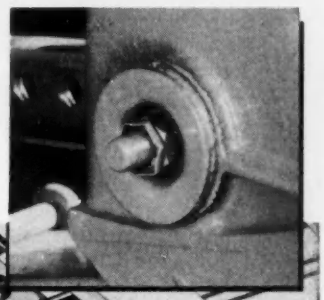
30 to Receive Awards From Technical Board

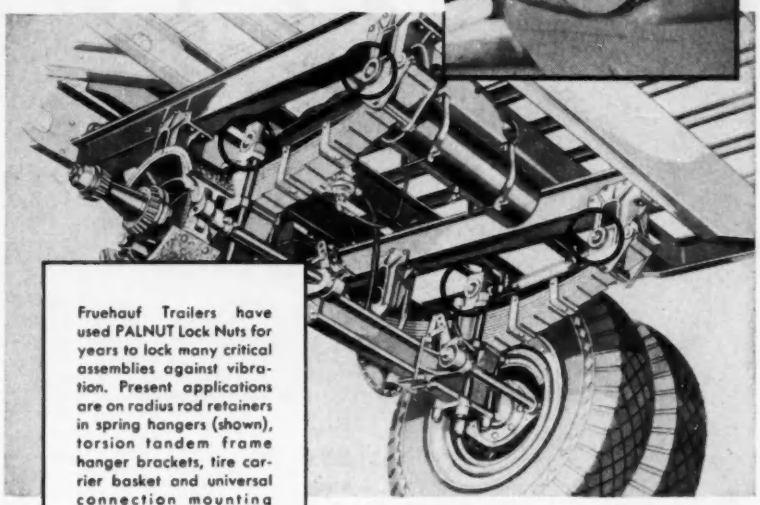
THE SAE Technical Board plans to present certificates of appreciation to 30 technical-committee members and former members at a luncheon on Thursday, January 13, during the SAE Golden Anniversary Annual Meeting in Detroit.

The recipients are to be honored for their outstanding contributions to the accomplishments of various technical committees. This is the second year in which such awards have been made.

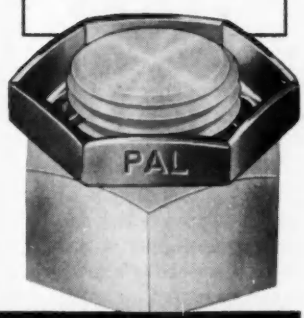
Technical Board Chairman William Walworth will present plaques to the men. All present and former members of the Board have been invited to attend.

How FRUEHAUF TRAILERS assure Vibration-proof assemblies with PALNUT Lock Nuts





Fruehauf Trailers have used PALNUT Lock Nuts for years to lock many critical assemblies against vibration. Present applications are on radius rod retainers in spring hangers (shown), torsion tandem frame hanger brackets, tire carrier basket and universal connection mounting brackets.



Regular Type PALNUT TRADEMARK LOCK NUTS

Many advantages of PALNUT Lock Nuts

• Absolute security • Lower cost • Fast assembly with hand or power tools • Space saving • Maximum bolt loading • May be removed and re-used • Withstand high temperatures.

Regular Type PALNUT Lock Nuts are used by the automotive industry on connecting rods, main bearings, engine mountings, shock absorber mountings, body hold down, brake parts, transmission housing, exhaust manifolds, etc. Send for free samples and Bulletin #577.

THE PALNUT CO., 70 Cordier St., Irvington 11, N. J.
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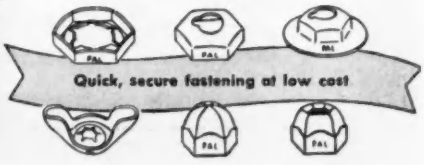


continued from page 85

than using strong solvents or oxygen burnout methods.

How It Works

The PDQ process removes combustion chamber deposits by a combination of heat, pressure, and abrasive action.

Heat—The fuel is ignited by the spark, as normally, but a substantial portion of it auto-ignites spontaneously. Peak temperatures in the chamber are higher than with regular tank fuel. This promotes deposit removal.

Pressure—The rapid release of energy accompanying autoignition creates high velocity pressure waves which knock the deposits loose from the combustion chamber walls.

Abrasion—These deposits are buffeted about within the chamber "sandblasting" remaining deposits before being blown out the exhaust.

What It Does

PDQ Carbon Remover is intended to reduce preignition, improve power, and lower octane requirements.

Preignition—Most present day gasolines and oils form combustion chamber deposits sufficiently high in both lead and carbon to encourage preignition. A chemical action between the lead and carbon produces hot spots which ignite secondary flame fronts. Although some fuel additives may reduce preignition, they adversely affect power by increasing the final equilibrium deposit level. Removing the preignition source instead of suppressing it seems to be a more effective approach.

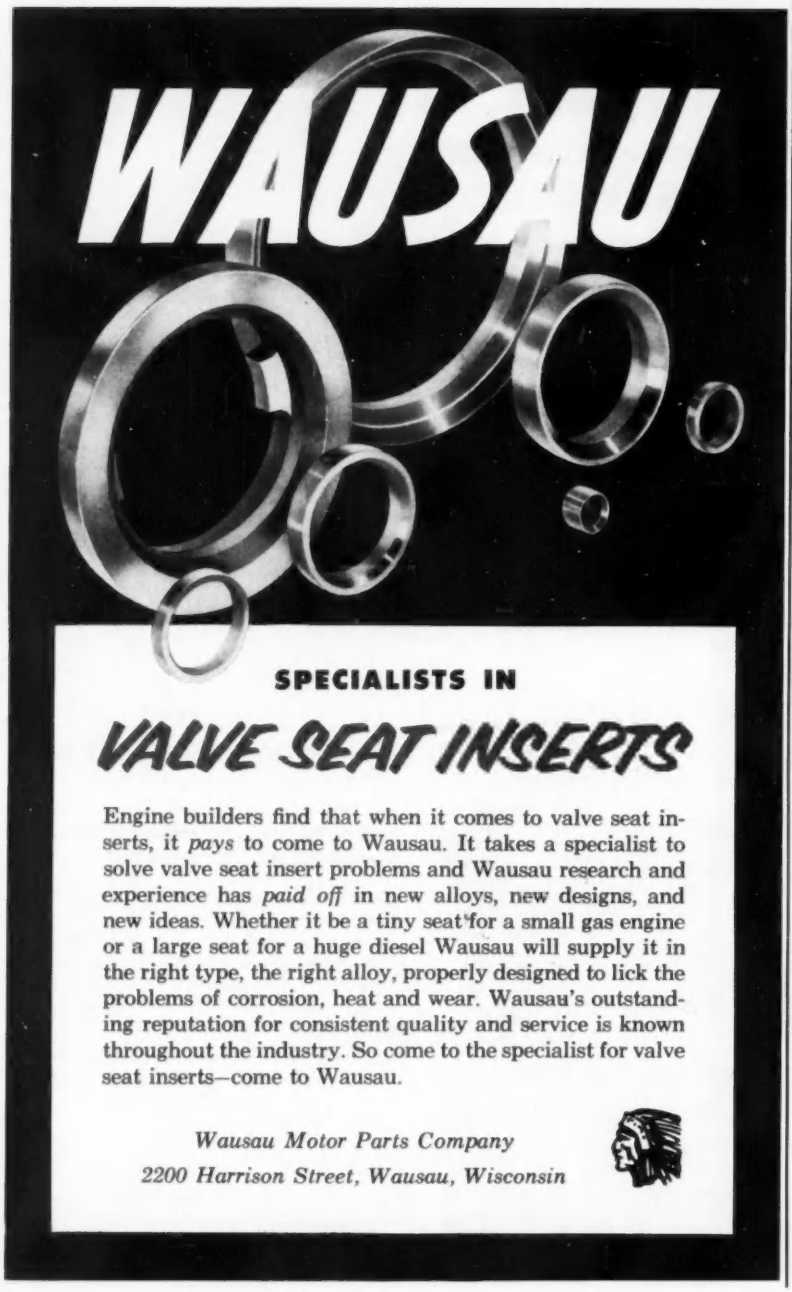
Power—Deposits reduce power primarily by heating up the incoming gasoline-air mixture. That lowers volumetric efficiency. The greater the deposit, the greater the power loss. By removing deposits, 5 to 10% increase in power is possible.

Octane Requirement—Combustion chamber deposits increase the octane requirement of a fuel rapidly during the first thousand miles. In 1500 to 5000 miles they reach an average equilibrium about 10 octane numbers above clean engine needs. Fig. 3 shows how the number of throttle openings during a treatment relates to octane requirement decrease.

In more than 75,000 engines, the rate of deposit after treatment was about the same as from an originally clean condition. The point at which a given engine again begins to knock depends upon the amount of treatment and upon the equilibrium octane requirement of the car relative to the fuel octane number.

Tests on 13 different American auto makes indicate the treatment has no adverse effects on the engine. Also, it is equally effective whether an engine is preignition or knock limited.

(Paper "Controlling Preignition By Deposit Removal" was presented at SAE Summer Meeting, Atlantic City, N. J., June 10, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members; 60¢ to nonmembers.)


WAUSAU
SPECIALISTS IN
VALVE SEAT INSERTS
Engine builders find that when it comes to valve seat inserts, it *pays* to come to Wausau. It takes a specialist to solve valve seat insert problems and Wausau research and experience has *paid off* in new alloys, new designs, and new ideas. Whether it be a tiny seat for a small gas engine or a large seat for a huge diesel Wausau will supply it in the right type, the right alloy, properly designed to lick the problems of corrosion, heat and wear. Wausau's outstanding reputation for consistent quality and service is known throughout the industry. So come to the specialist for valve seat inserts—come to Wausau.
Wausau Motor Parts Company
2200 Harrison Street, Wausau, Wisconsin

How Oils Affect Owner-Driven Cars

Based on paper by

P. A. BENNETT
and
J. R. LANDIS
General Motors Corp

TESTS with customer-owned and driven cars have shown that lubricating oil affects octane-number re-

quirement to the magnitude of 3 octane numbers. This compares with a 6 to 8 octane-number requirement effect found in controlled laboratory tests. The importance of this effect lies in the fact that 3 octane numbers is equal to one-half the difference in octane quality between the average regular- and premium-grade gasoline.

Seventeen privately owned cars were used for the test. All were 1952 models of the same make and new at the start of the test. Two types of oil were used—oil A, a commercial, high V.I., paraffinic-base oil containing bright stock and, oil B, especially blended from a commercial, low V.I., naphthenic-base oil containing no bright stock. Detergents and V.I. improvers were added to oil B to satisfy engine cleanliness and oil consumption.

When data were separated according to the lubricant used (Fig. 1), 92 Research octane-number severity reference fuel was shown to satisfy 30% of the cars using oil A and 80% of cars using oil B. At the 50% point there is a difference of 3 octane numbers in maximum octane-number requirement, due to the effects of lubricating oil on combustion-chamber deposits. (Paper "Effects of Lubricating Oil on Octane Requirements of Cars in Customer Service" was presented at SAE Cleveland Section, Jan. 18, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

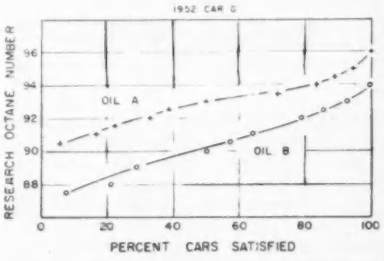


Fig. 1—Results of tests run with 17 privately owned cars of a single make are plotted here to show distribution of maximum octane number requirements according to oil used. At the 50% point there is a difference of 3 octane numbers.

Ceramic Coatings On Eve of Expansion

Based on paper by

JOHN V. LONG

Solar Aircraft Co.

CERAMIC coatings provide the designer and engineer with a material having the wearing properties of the base metal and the protective properties of glass. In general, the basic property is the protection of metal against oxidation and corrosion at high temperature. Primary differences in the coatings are workability, firing range, and the metal to which they are applied.

Among coatings under development are ones which variously protect 17-7PH against the attack of red fuming nitric acid, resist molten metal, resist gall and abrasion, and serve specific uses in combination.

We now have a coating which, in laboratory test, has resisted white and red fuming nitric acid at 90F for over three months without even losing its surface gloss.

Through the application of another especially developed coating we have

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Wausau Motor Parts Company
2200 Harrison Street, Wausau, Wisconsin

been able to extend the life of thermocouple wells in Kirk pots from 30 to 60 days. Thus, it has been possible to develop a coating resistant to the attack of molten metal.

Ceramic coatings can now be used in place of hard chromium plating to meet the problem of galling and siezing of rubber parts. The ceramics have a superior service life, are less costly, and use no strategic material.

A recent development, which may solve a number of problems, involves the use of combination coatings. We have coated an exhaust manifold with Surfaloy A on the inside and Solaramic 5210-2C on the outside. Surfaloy A is an aluminum coating applied by ceramic process. Under heat it develops an aluminum oxide surface which, in combination with the aluminum which alloys with the base metal, should give a high reflectivity.

The outside coating will provide high emissivity, thus allowing the metal to operate at a lower temperature. Surfaloy A does not become plastic at operating temperatures and should help to solve some of the impingement type erosion problems. Laboratory tests of the Surfaloy treatment give great promise.

(Paper "Ceramics — Development, Selection, Quality Control" was presented at SAE Northwest Section Meeting, Seattle, March 11, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

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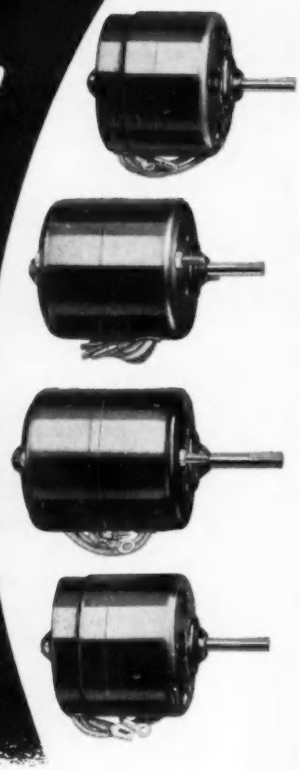

Leece-Neville Small Motors are produced for automotive use in 6 volt to 32 volt systems. Higher voltage motors are available for other applications. For full information, write The Leece-Neville Company, Fractional H. P. Motors Division, Cleveland 13, Ohio.

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AUTOMOTIVE ELECTRICAL EQUIPMENT SINCE 1909

New Air Brakes Cut Application Time

Based on paper by

STEPHEN JOHNSON, JR.

Bendix-Westinghouse Automotive Air Brake Co.

BRAKE manufacturers can do little or nothing to improve driver perception-reaction time, but they can improve brake application time and that has been done. Since World War II great strides have been taken and, more recently, further reductions in application time have achieved with the use of new, larger capacity equipment.

The following five examples will

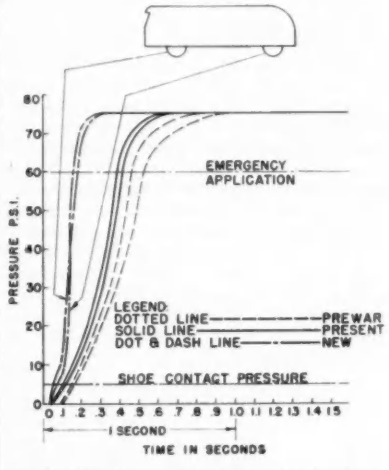

Fig. 1—This diagram illustrates what has been accomplished in the reduction of air brake air application times on a motor coach. Similar gains have been recorded when new larger capacity braking equipment was used on various combinations of trucks, trailers, and semi-trailers

illustrate the accomplishments with various vehicles and combinations:

Example I—A typical 35-41 passenger motor coach (Fig. 1).

Prior to World War II application time for brakes of the front axle was 0.46 sec and for the rear axle 0.53 sec, when compared at the 60 psi line, our standard of comparison. After the war these times were reduced to 0.39 sec for the front and 0.42 sec for the rear. With new larger capacity equipment this further reduced to, front 0.18 sec and rear 0.16 sec. Here not only were times reduced, but the rears take effect before the fronts.

Example II—A heavy-heavy 4-wheel tractor and tandem axle semitrailer.

Prior to World War II, application time for the tractor rear axle was 0.50 sec and the trailer tandem axle 0.74 sec. With present equipment these were reduced to 0.31 and 0.43 sec, respectively. With the new equipment a further reduction brought the time down to 0.23 and 0.30 sec, respectively.

Example III—A typical light-heavy 4-wheel tractor and tandem axle semitrailer combination.

With present equipment, the application times were: tractor front 0.19 sec, tractor rear 0.20 sec, and trailer tandem axle 0.27 sec. With new larger capacity equipment, these times became 0.20, 0.21, and 0.22 sec, respectively. The chief advantage gained in this combination is the reduction in time spread between the axles. The old spread was 0.08 sec and the new spread 0.02 sec.

Example IV—A typical heavy-heavy 6-wheel tractor, tandem axle semitrailer and 4-wheel full trailer combination.

This combination has one of the most involved brake systems. Lengths of tubing and hose to reach from the brake valve to the tractor to all the axles are of considerable magnitude. For example, the length to the rear axle of the full trailer was 67 ft.

Air application times with present production equipment were: tractor front, 0.24 sec; tractor rear, 0.35 sec; semi-trailer, 0.48; and full trailer, 0.52 sec. With the new equipment times were: tractor front, 0.26 sec; rear, 0.35 sec; semi-trailer, 0.40 sec; and full trailer, 0.42 sec. Here the objective was chiefly to reduce trailer times to achieve a better uniformity of air application or synchronization.

Example X—A typical 6-wheel truck and 6-wheel trailer with front dolly.

With present production equipment application times were: truck front, 0.30 sec; rear, 0.40 sec; trailer front, 0.31 sec; and rear, 0.38 sec. With new larger capacity equipment the application times became: truck front, 0.28 sec; and rear, 0.28 sec; trailer front, 0.26 sec; and rear, 0.29 sec. Thus, the application time of each axle could be reduced in varying amounts and effect a reduction of time spread of 0.1 to 0.03 sec.

The improvements indicated in the example were accomplished, in most cases, by the simple substitution of a new larger capacity valve for the pres-

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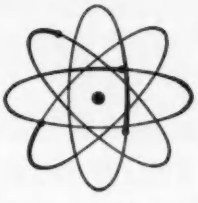

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ent design while the rest of the brake system remained unchanged. (Paper "Air Brakes and Braking Performance" was presented at SAE Northwest Section, Seattle, April 9, 1954, SAE British Columbia Section, Vancouver, April 12, 1954, SAE Oregon Section, Portland, April 15, 1954 and SAE Spokane-Intermountain Section, Spokane, April 16, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

Unique Assembly Ups Hawker "Hunter" Output

Based on paper by

E. H. JEFFERSON
Hawker Aircraft (Blackpool) Ltd.

TO facilitate manufacture of the Hawker "Hunter" under the forced draft occasioned by national rearmament and the offshore procurement program a common assembly practice has been carried to an extreme. The "Hunter" is broken down into a number of main assembly units such as the front fuselage, center fuselage, rear fuselage, wings and so on. Each of these components is built not only as a separate unit but absolutely complete in itself, containing all its ancilliary equipment, services, pipe and electric runs, just as it will in the finished aircraft. When the components come together for final assembly, it remains only to connect up the structural members and plug the pipes and electric leads together.

One reason for adopting this practice was to overcome the difficulties inherent in building an airplane in factories dispersed over a wide area. It has proved invaluable to Hawker and again, now that offshore orders have been placed with Holland and Belgium, in coordinating production efforts on the Continent.

During peacetime, dispersed production is a severe handicap; but in time of war it can be an asset, as experience during the last war proved. Every one of our jigs can be dispersed within a short space of time. All main jigs are designed so that they are erected on rafts made of a structure of rising steel joists welded together and provided with jacking points for leveling up. In an emergency, the complete units can be removed to a safe area. (Paper "Three-Nation Correlated Production of the Hawker 'Hunter' Under O.S.P." was presented at SAE National Aeronautic Meeting, New York, April 14, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price 35¢ to members, 60¢ to nonmembers).

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Tests Help Clarify Abnormal Combustion

Based on paper by

J. R. LANDIS
Research Laboratories Div.,
General Motors Corp.

TO investigate the affect of combustion chamber deposits and fuel octane number on abnormal combustion, a series of tests were run using independent or non-firing spark plugs as ionization gaps together with a Socony-Vacuum Engine-Analyzer oscilloscope. From this the following observations were made:

There are two kinds of abnormal combustion—the continuous or sustained type and the scattered or isolated abnormal explosion.

The continuous type was affected definitely by fuel octane number. It

was eliminated by removing a part of the combustion chamber deposits, and was readily identified by the "ignition off" technique.

The scattered abnormal explosion was not affected significantly by octane number. It was eliminated by removing a substantial amount of combustion chamber deposit, and it could not be identified by the "ignition off" technique. (Paper "Detection of Abnormal Flame Fronts in Road Tests With an Engine Using Independent Ionization Gaps" was presented at SAE Summer Meeting, Atlantic City, June 10, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers.)

When to Change Heavy Duty Oils

Based on paper by

H. M. GADEBUSCH

Detroit Diesel Engine Division,
General Motors Corp.

THE primary function of crankcase lubricants, that of minimizing wear, has long been overshadowed by two other equally important duties. The first is to provide internal cooling for all rotating parts. The second is to remove all foreign contaminating materials from the moving surfaces. The complexity of this task is made apparent by Fig. 1.

Oil filters help in eliminating sludge-forming contaminants once they have reached the crankcase, but they cannot prevent cylinder wear due to abrasive dirt contained in the intake air, or deposit formation due to soot accumulation on pistons, oil control rings, and in the air intake ports of two-cycle engines. Here's where detergents play their part. They make sludge formation practically impossible by intimately dispersing all organic contaminants throughout the oil.

Since detergent chemicals are definitely exhaustible and each molecule can develop, disperse, and suspend only a finite amount of contamination, the question arises when should oils be renewed. This cannot be answered by any simple test method. There is, however, a practical means of avoiding exhaustion of the detergent compounds; that is, to inspect the oil filter elements. Common sense then dictates this rule: If, at the time of an oil change, the filter elements are found coated with sludge, the oil change period must be reduced, or a lubricant of the next higher detergency level must be used. (Paper "Theory and Practice of Diesel Engine Operation" was presented at SAE Pittsburgh Section Meeting, April 27, 1954. It is

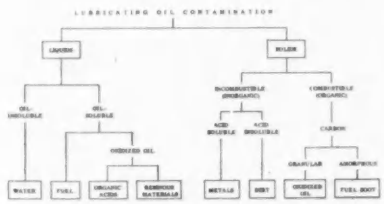

Fig. 1—Lubricating oil has a tough job removing all foreign contaminating materials from moving surfaces. The complexity of the task is made apparent by showing the variety of liquid and solid contaminants involved

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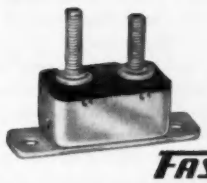

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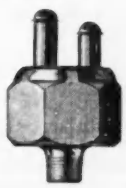

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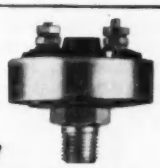

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Cabs Winning Favor With Heavy Tractors

Based on paper by

JOHN C. ENBLOM

Crenlo, Inc.

HEAVY duty tractor cabs are being used widely in such operations as logging, quarrying, mining and construction, to mention a few. Cabs are most popular on motor graders, 80 to 85% of all machines being so equipped. On crawler tractors, the most emphasis has been placed on larger sized machines. The high-speed, rubber-tired tractor in combination with scraper or wagon is now being equipped with cab more often, and this is true also of such tractors equipped with front end loaders or shovels.

Tractors, graders and scrapers are designed to move dirt at the lowest possible cost per yard. There is evidence that a well designed cab will increase savings in many types of operation. These savings may be due to:

1. More hours of operation,
2. Higher driver productivity,
3. Less damage to equipment,
4. Reduced losses from accidents, and
5. Better driver morale.

Much remains to be done to develop cabs designs that will meet the test in operators, hands. The product the field is looking for can be produced by close cooperation between tractor engineers and cab designers. (Paper "Heavy Duty Tractor Cabs" was presented at SAE National Tractor Meeting, Milwaukee, Sept. 14, 1954. It is available in full in multilithographed form from SAE Special Publications Department. Price: 35¢ to members, 60¢ to nonmembers).

Based on Discussion

Robert L. Allen, Allen Industries Products, Inc.

Cab design starts with the tractor manufacturer. He may design his own, or use the services of an outside cab designer and manufacturer. For really satisfactory cab design, the machine must be planned for it, regardless of who does the final cab designing.

Cab planning should not increase the cost of the machine, but it would certainly have a favorable effect on the cab price and would reduce substantially the present high cost of installation and fitting. Look not at the small percentage figures of the past, but at the importance of the equipment sale today and the unmistakable trend to cab use.

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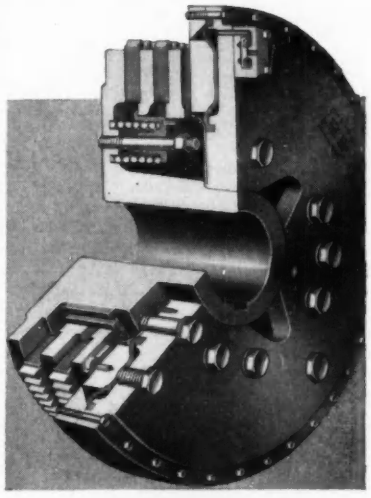

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News About Special Publications

MORE THAN 1500 PRODUCTION MEN jammed session rooms at the Hotel Statler in Los Angeles last October at the Aeronautic Production Forum. You can get the same meaty ideas these men got by ordering SP-309, a complete report of the 10 panels at this Forum. Packaged in this one volume are the latest methods of coping with today's aircraft manufacturing problems. The report is yours for $2.00 if you're an SAE member, $4.00 if you're not.

Driving safety is like the weather. Lots of people talk about it, but few do anything about it. Amos E. Neyhart is

Amos E. Neyhart

one who has done something, a great deal in fact. That's why he was chosen as the eighth recipient of the David Beecroft Memorial Award. **His Beecroft Lecture, "Driver Education—The Key to Safe Operation of Motor Vehicles," is a program blueprint for training young drivers as well as adults.** Copies of the Lecture (reprints of Journal article), will be available for 35¢ to SAE members, 60¢ to nonmembers.

Valve lifters again are in the limelight as a result of the new V-8 engines recently introduced. Engineers now are wrestling with cam and tappet wear. What's being done about the problem and effectiveness of various surface treatments get a pretty thorough airing in SP-127—Symposium on Cam and Tappet Wear Problems. Three papers and discussion included disclose the latest state of the art. The price is $1.25 to members, $2.25 to others.

Did you ever find yourself in need of the latest technical literature on a subject to get your teeth into a new project? At a time like that, **the SAE Special Publications checklist can come in mighty handy.** It lists all SAE papers currently available in multilithographed form, by subject, as well as technical reports. It's **FREE**, just for the asking. To get your copy, write to SAE Special Publications Department, 29 West 39th Street, New York 18, N. Y.

SAE Special Publications has distributed more than 1,000,000 copies of SAE technical committee reports, meetings papers, and other special publications in the 10 years since its inauguration in 1945.

The start of this member service was made under the leadership of SAE Past President W. S. James, when he became chairman of the SAE Publication Committee the year following his presidency.

Under Publication Committee Chairman T. B. Rendel, Special Publications has continued successfully on its original policy of operating on at least a self-sustaining basis.

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"HOW-TO" is just as important for the vehicle design engineer as it is for the do-it-yourself home owner. That's why the "Design, Evaluation, and Selection of Heavy-Duty Rear

K. W. Gordon

Axles," by K. W. Gordon, Chrysler's Dodge Truck Division, looks like a solid addition to the literature. IT'S THE STORY IN A NUTSHELL on how to pick the right axle for a given vehicle. Incidentally, Gordon's paper is the first L. Ray Buckendale Lecture, a lecture series to commemorate the contributions of SAE Past-President Buckendale.

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New Members Qualified

These applicants qualified for admission to the Society between October 10, 1954 and November 10, 1954. Grades of membership are: (M) Member; (A) Associate; (J) Junior.

Atlanta Group

Charles H. Dolson. (M).

Baltimore Section

Gilbert C. Bellistri (J), James C. Emanuel (J), Richard M. Hecht (J), Donald N. Liechty (J).

British Columbia Section

George Albert Cotton (A).

Buffalo Section

Lloyd Edward Gomez (J), John E. Keane (J), Robert E. Lenz (M), Harvey David Prace (J), Joseph D. Ryan (A), William C. Warren, III (A).

Canadian Section

Ernest W. Bartle (M), James Grant Dykes (A), Donald C. MacKenzie (J), Joseph James Walker Morrison (A), Edward Carl Pecheniuk (J), Alexander W. Peev (J), Frank Donald Shaw (J).

Central Illinois Section

A. G. Heisel (M).

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Arthur C. Achterberg (M), Charles Frederick Bacon (J), Robert A. Bell (M), Claud A. Fenn (M), James Edward Getz (J), Rader O. Hale (J), John A. Halgren (M), John W. Hancock (J), Harold G. Hanlin (A), Herbert K. Holm (M), R. L. Larson (M), Joseph M. Liebig (M), Harry E. Starr (J), John Roger Tulach (J), Joseph Thomas Vidmar (J), Kenneth E. Whiteley (A).

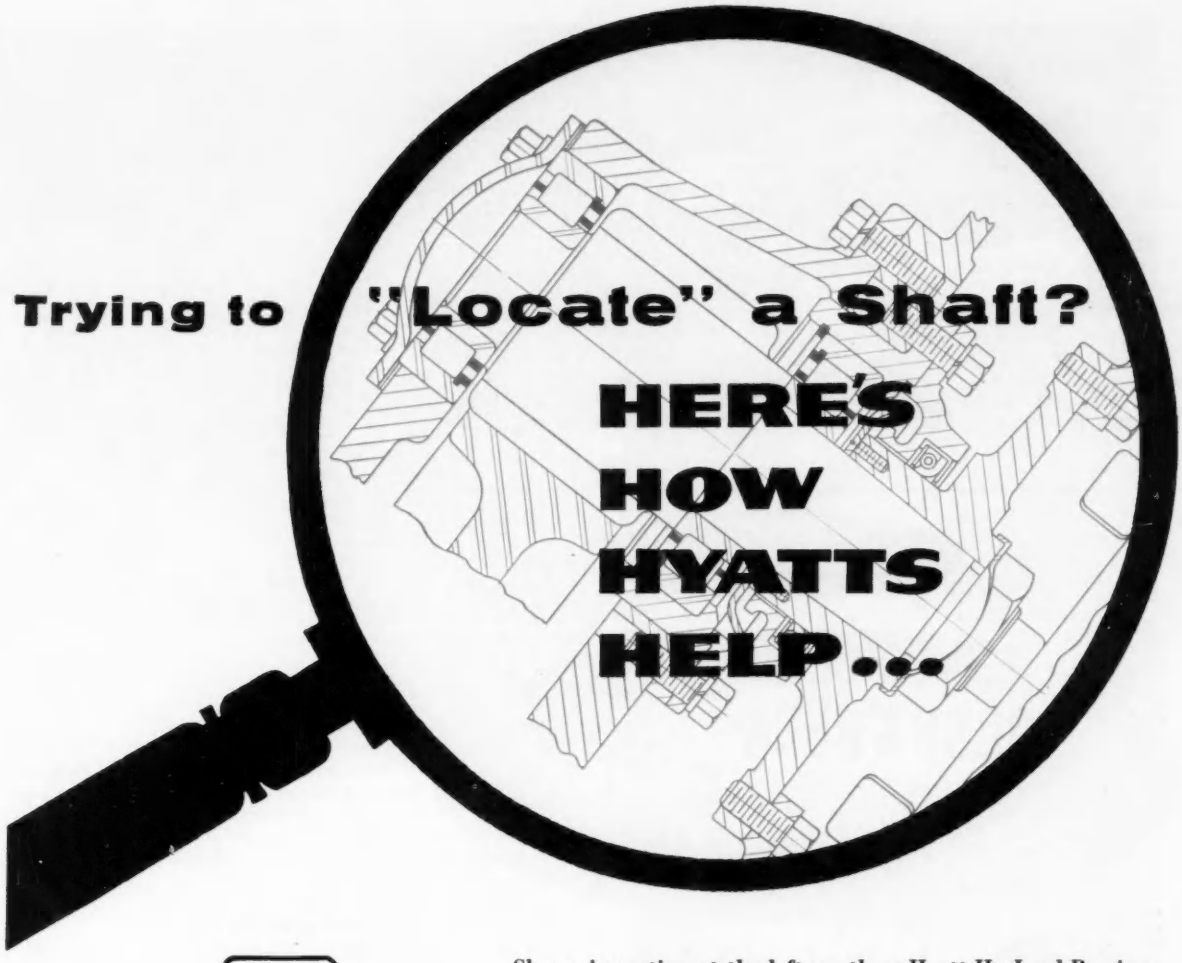
Cincinnati Section

Hugh F. Huggin (A), Robert F. Klein (J), Bertram W. Mahoney (M), John G. McKinney (A), Alfred Gregory Orillion (J), William Robinson Timmer (J).

Cleveland Section

Donald F. Collins (J), Barton C. Conant (J), Ernest H. Dawson (M), Robert J. Fay (A), Albert R. Galasso (M), Robert C. Gannett (A), Gerhard A. Hauser (J), Russell F. Klatt (M), Wayne C. Kunde (J), L. Abbott Leissler (J), Alfred O. Luning (A), Mark M. Miller (A), Thomas Osters (J), Richard B. Robinson (M), Elverton O. Roe (M), Erhart E. Sonntag (M), Harold Edward Thomas (J), William Thomas Wintucky (J), B. C. Yearley (M).

Trying to "Locate" a Shaft?



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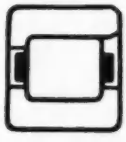
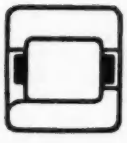
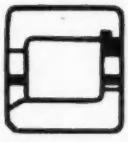
3 TYPES



BU-L
separable outer race series



R-WB
separable inner race series



R-YS
separable inner race series

Shown in section at the left are three Hyatt Hy-Load Bearing types that are used for axial shaft location. Flanges on inner or outer races limit axial shaft movement and permit the bearing to take light, intermittent thrust loads.

Since Hyatt inner races are assembled on shafts, with relatively heavy press fits, no accessory parts are necessary to hold them in place.

Hyatt Hy-Load Bearings are available with a variety of combinations of race flanges, snap rings, cages or separators, so that just the right combination can be selected for each set of operating conditions.

Hy-Loads are available in three diameter series, two widths and a complete range of sizes. For complete information write for Catalog 150—Hyatt Bearings Division, General Motors Corporation, Harrison, New Jersey.

HYATT ROLLER BEARINGS

STRAIGHT BARREL TAPER

New Members Qualified

continued

Colorado Group

Joseph T. Keeley (J).

Dayton Section

Charles L. Babb (M), James Edward Gause (J), Curtis P. Kelley (M), Donald Jesse Mathias (J), Loy D. Rhoads (M), Robert A. Rodgers (M), David Anthony Trayser (J).

Detroit Section

Russell A. Ash (J), N. George Avram (J), Robert H. Bauer (J), William T. Birge (J), Paul J. Blinkilde (J), Benjamin Franklin Boehm (J), Ward Scott Bryson (J), William Campbell (J), Forrest R. Cheek (M), James D. Clifford (J), Joseph Benjamin Conte (J), Howard L. Croswhite (J), Lloyd F. Curby (J), Wilber E. Davidson (J), J. Thomas Dawes (A), Robert A. Dezelick (J), Richard R. Embry (J), John E. Fahlgren (J), Thomas J. Feaheny (J), Robert Millard Fenkell (A), Donald John Fergle (J), H. William Gilbert (J), Chavali Venkata GopalaRao (J), Frederick A. Hagen (J), Virgil A. Heck (M), Ivan R. Johnson (J), Joseph A. Johnson (J), Paul R. Johnson (J), Harold M. Kimball (A), William F. Lomas (M), H. Robert Lucas (M), Harold Hammond Macklin, Jr. (J), Joseph F. Macura (J), Calvin K. Miller (J), Thomas Edward Miller (J), George H. Moore (J), Jack E. Morgan (J), Donald D. Nelson (J), A. C. Norris (M), William F. Nunnold (J), Leonard Obrebski (J), Roy A. Oja (J), William E. Oram (J), Robert C. Penn (J), Henry M. Porter (A), David Van Potter (M), Robert William Reinhardt (J), Alexander Reynolds (M), Jack Melvin Roberts (M), Elmer J. Rohn (J), Donald Irwin Rohrbach (J), Aaron D. Rosenstein (J), Karl Schwarze (J), John Reynolds Secord (J), Earle H. Stepp (J), William J. Streetman (J), George B. Stringfellow (A), George E. Swick, Jr. (J), Ralph F. Todd (J), Ralph William Van Demark (J), Melvin F. Veitengruber (J), Frederick Herbert Wagman (A), Leslie M. Wallace (J), Thomas J. Walsh (J), Frederick B. Wiggins (J)

Hawaii Section

Antone Milho (M).

Indiana Section

Virgil L. Alexander (M), Thomas John Baldauf (J), Dario R. Gross (J), Paul M. McLear (J), Howard August Peterson (J), John Howard Rayle (J), Emil Suchy (A), James Allen Williams (J).

Kansas City Section

Allan Chilton (M), Frank G. Schmidt, Jr. (J), Frederic T. Weisman (J).

Metropolitan Section

Andrew R. Barr (M), Jack Beech (J), Julian Phillip Berch (J), Casimir Biebers (J), Eugene F. Cramer (J), R. Cubicciotti (M), Robert Dagna (J), Allan E. Daly (A), Clifford Roland Daly (J), Charles B. Goldman (J), William C. Goodwine (A), Ernest E. Heins (A), Sanford Herman (J), Daniel W. Kaplan (J), Rolf W. Lange (J), Vincent R. La Vigna (M), Robert B. Lea (M), Martin Leff (J), Walter J. McCullough (J), William Vincent Oakenell (J), Temple Chapman Patton (M), Robert C. Rame (J), Paul R. Rhinehart (J), Frank Schumann (J), Miller W. Swaney (M), Ronald E. Trenkner (J), Robert Turton (J), Harold Wanaselja (J), Lewis A. Winkler (M).

Mid-Continent Section

Wendell R. Dieman (J), Marvin Whitlock (M).

Mid-Michigan Section

Charles Hudson Butcher, Jr. (J), James M. Combest (J), Dominick Joseph DeFazio (J), Robert E. Fisher

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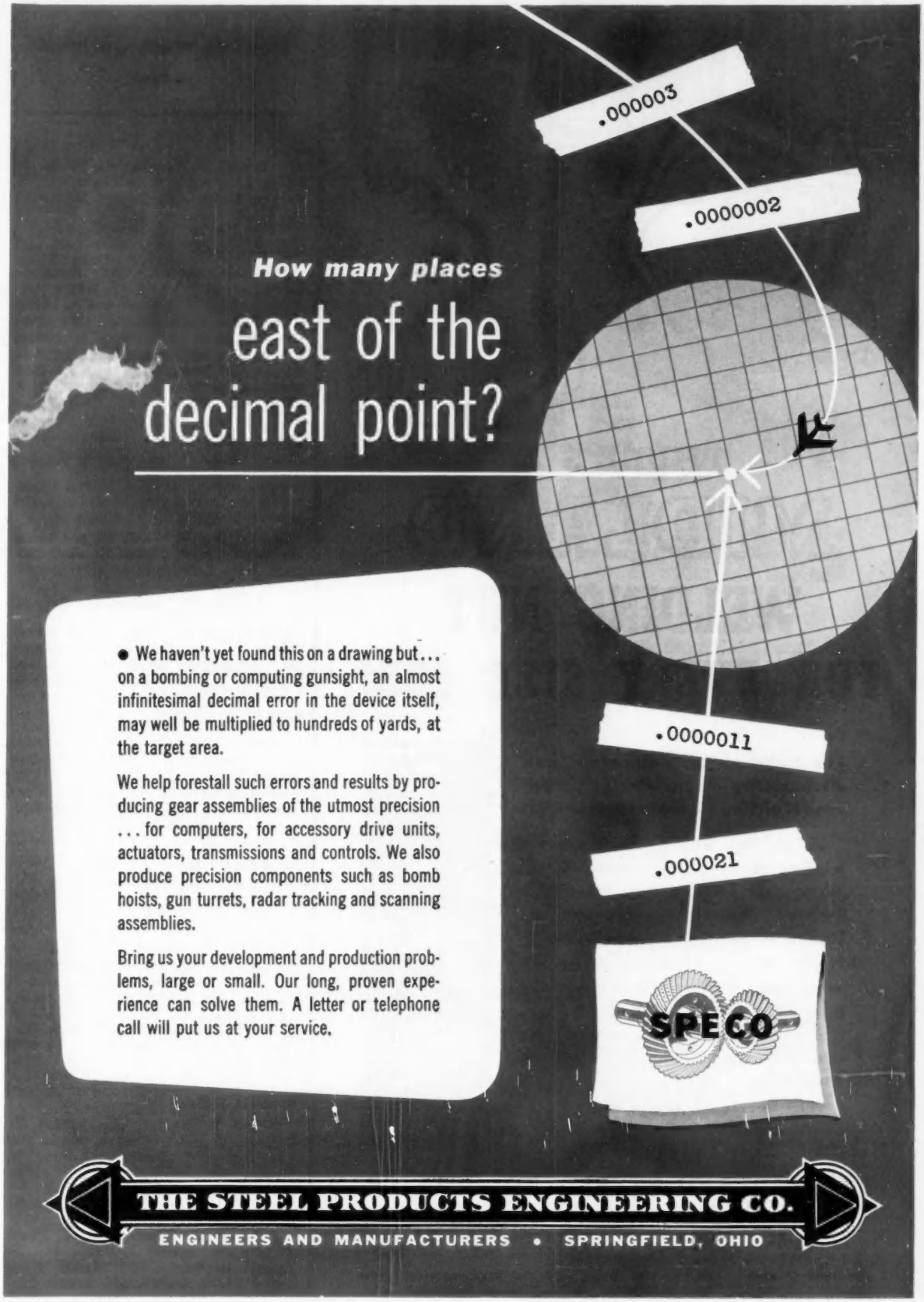

• We haven't yet found this on a drawing but... on a bombing or computing gunsight, an almost infinitesimal decimal error in the device itself, may well be multiplied to hundreds of yards, at the target area.

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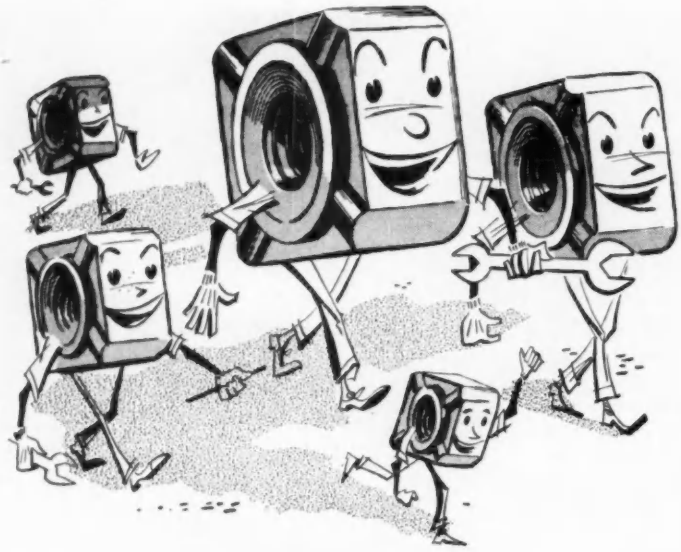
Bring us your development and production problems, large or small. Our long, proven experience can solve them. A letter or telephone call will put us at your service.



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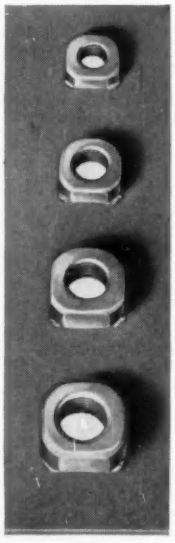

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New Members Qualified

continued

(J), Robert P. Forella (J), Verlin P. Miller (A), John F. Sellinger (J), S. Vernon Stoker (J), Robert M. Tullos (A).

Milwaukee Section

Fred G. Burdick (M), Elroy L. Gerschke (A), Jerald D. Hinke (J), John P. Kuly (J), Lawrence A. Lange (J), George Thomas Miller (M), John E. Obernesser (M), Harry C. Probst (J), Lowell M. Schmidt (J), Max B. Shipley (J), Vernon G. Sommers (M), Matthew J. Wenner (M), Robert C. Wiczynski (J).

Mohawk-Hudson Group

Fil L. Fina, Jr. (J), Carl E. Pearson (J).

Montreal Section

Gaetan Bienvenu (A), Victor Charles Korcz (J), John Clifton Stewart (M), Jack Peter Toronchuk (J).

New England Section

Aydin Cansever (J), Walter James Eager, Jr. (J), Edward P. Edmunds (A), Hal B. Stetson (A), Peter Caldwell Tappan (J), Vincent G. Terry, Jr. (J).

Northern California Section

Herbert Victor Baak, Jr. (J), George U. Brumbaugh (M), George Condrashoff (J), James M. Duffin (J), Vincent Daniel Franger (J), Neal Pardee Kirkham (J), David Kenneth McKinley (J), Philip P. Zuniga (A).

Northwest Section

Jack Leonard Gregory (J).

Philadelphia Section

Edward H. Bacon (J), Wesley F. Carroll, Jr. (J), Richard E. Crosthwait (J), Frank J. Heymann (J), John B. Janney (M), Eugene Samuel Lubarsky (J), William G. Mears (J), Paul H. Miller (J), Wallace A. Portouw (J), Edwin E. Ritter (M), Frederick Carl Schwartz, Jr. (J).

Pittsburgh Section

Albert B. Baxter (J), Parker W. Dobson, Jr. (A), Charles E. Shields (J), Robert A. Stough (J), Fred W. Walker (M).

St. Louis Section

Bert James Bartlett (J), Frank Pichon (J), James J. Ryan, Jr. (J), Lyndel B. Schild (J), Myron Tygar (J).

New Members Qualified

continued

Salt Lake City Group

Fred L. Sommercorn (J).

San Diego Section

Rodney Allan Hidde (J), Roberts Roy Hoover (M), Waldon W. Schmidt (J), Curtis M. Smith (J).

Southern California Section

Chester A. Barrand (M), Lloyd W. Bartlett (J), Marshall H. Brown (J), Ralph Earl Cornwell, Jr. (J), Leonard E. Edelstein (J), Alan M. Haire (J), Arthur N. Heath (J), Claude W. Hess (J), Lyle E. Hiatt (A), Myron S. Jackson (M), Richard W. King (J), Stanley J. Kukawka (J), John Kulachkosky (J), Herbert M. Kurit (J), Walter E. Leser (J), Craig Marks (J), Marvin Paul McCollum (M), Paul Weber O'Meara (M), George Vernon Roark (M), Melvin Curtis Sanders (J), Edwin Stear (J), Howard Frank Tietjen (J), Forest M. Wilhite (J), Raymond A. Young (M).

Southern New England Section

Edward A. Avery (J), Frank J. Bobryk (M), Reinhold H. Hollinger (J), Lloyd I. Krause (J), David John McGregor (J), Rudolf Oeky (M), Hugh McVeigh Perkins, Jr. (J), Seymour Roth (J), John Russell Sved (J), Sterling B. Withington (M).

Syracuse Section

Nathan P. Hughes (J), Isam S. Nimr (J), Reymont Szeliga (J).

Texas Section

D. L. Hearn (J), Merle C. Mueller (J), William A. Patrick (A), Galdino Salvador (J).

Twin City Section

Marvin J. Samuelson (M), Lester D. Savage, Jr. (J).

Washington Section

D. Barry Boyce (J), Manuel Ceballero (J), Morris B. Flint (M), Randall Goff (J), Joseph S. Murphy (A), George William Wagner (M), Stirling S. Wilson (J).

Western Michigan Section

Earl Dean Allen (J), Ivan E. Parsons, Jr. (M), Harry Leon Stryker (J).

Wichita Section

Kenneth Wilton Rix (J).

Williamsport Section

C. Frank Pannebaker (M).

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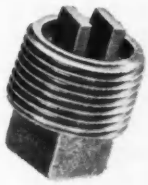
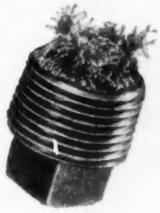
Small, metallic particles are constantly flaking off moving parts in engines, transmissions, and rear axles.

A strong, permanent magnet in the LISLE PLUG attracts and holds these metal particles, prevents them from circulating in lubricants. This eliminates a common cause of costly, premature wear.

Replace Ordinary Plugs with LISLE PLUGS



To Remove IRON and STEEL Particles from Oil



Sample LISLE PLUGS sent at no cost to you for testing. Simply state size and type of plug desired.

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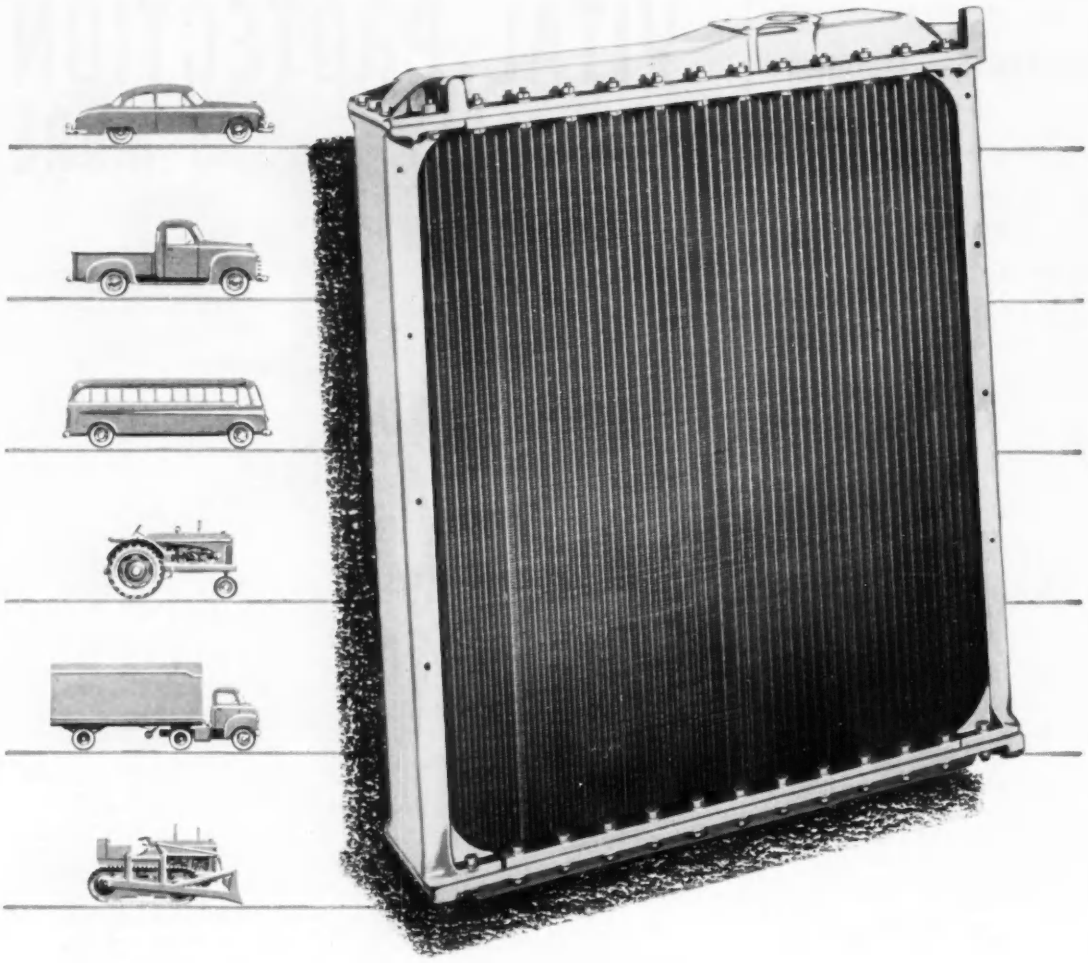

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Too little or too much heat prevent an engine from giving peak performance. "Balanced cooling" protects and prolongs fine performance. For over 50 years, as specialists in radiator manufacture, we have been providing efficient "balanced cooling" systems for car, truck, bus, tractor, stationary and diesel engines. This lifetime of experience assures you unparalleled engineering design and production skill, and the widest range of radiator sizes and capacities.

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New Members Qualified

continued

Outside Section Terrtory

Charles R. Allen (M), Louis M. Bachinski (J), 2nd Lt. James L. Bomberger (J), William Allen Elston (J), Edward C. Erickson (J), John S. Gabel (J), William L. Giles (J), Donald George Hall (J), William F. Laser (M), Irvin W. Lee (A), Wendell E. Marchant (A), George H. Michael (J), John Allen Mihaloew (J), George Louis Muller (J), Paul S. Sawyers (M), William G. Slater (J), Roy Henry Springborn (J), Gerald A. Stoltenberg (A), Alton M. Williamson (J), 2nd Lt. John D. Withrow Jr. (J), Arnold W. Wolfgong (M).

Foreign

Rodrigo C. Fuentes (J), South Amer.; Donald Everett Hilberg (J), Venezuela; Alexandre Jacques Mura (M), France; M. A. Raouf (J), Pakistan; Y. S. Somayajulu (J), South India; Hanji Umehara (M), Japan; Kiyoshi Yamoto (M), Japan.

Applications Received

The applications for membership received between October 10, 1954 and November 10, 1954 are listed below.

Alberta Group

Fred P. Clark, Jr.

Atlanta Group

E. Charles Clifton, Alvin G. Folger, Carl F. Friend, Pete G. George, Jr.

Baltimore Section

Wilbur C. Kern.

Buffalo Section

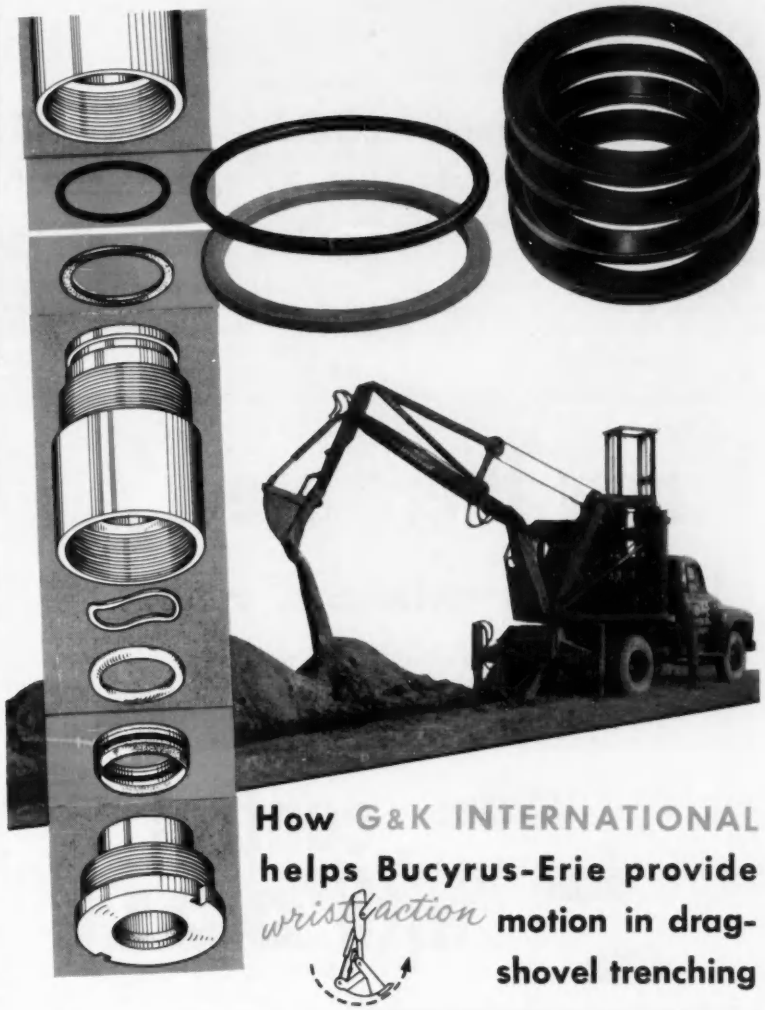
Donald P. Cryor, Paul F. Furgerson, Elbert R. Hubbard, George F. Kappelt, John F. Nagowski.

Canadian Section

Sidney G. Letts, Keith Pettigrew, Frank Sommers, Bertram Tilley.

Central Illinois Section

Harrison F. Cox, Herman J. Eppink, Irwin L. Joslin, Walter E. Lott, William E. Parker, Walter I. Nelson, Jr., Ben M. Pollard, Ernst F. Schenke, Herbert L. Vernon, Clifton Weaver, Jr.



How G&K INTERNATIONAL helps Bucyrus-Erie provide *wrist action* motion in drag-shovel trenching

Twelve G&K-INTERNATIONAL packings are installed in the dipper tilting ram of the new Bucyrus-Erie Hydrohoe: five in the housing and seven in the ram piston assembly.

This ram is mounted on the "forearm" of the Hydrohoe, and gives the dipper "wrist action" motion, providing a secondary and shorter radial digging arc. The ram must extend and retract, and respond to "finger-tip" control.

Two sets of one synthetic rubber and three leather V-packings with packing wave springs are opposed on the ram piston assembly, and an O-Ring is used as a static seal. In the housing (illustrated), another set of four V's prevents leakage around the shaft, and the housing assembly is made fluid-tight by a static O-Ring seal with back-up washer.

Packings such as these, precision-manufactured by G&K-INTERNATIONAL, provide the design engineer with standard and special types in leather or synthetic rubber to meet all requirements in hydraulic and pneumatic power applications.

Write for G&K-INTERNATIONAL Catalog and Manual 201-A. 60 pages of up-to-date data including latest JIC and officially recommended sizes for all types of packings.

G&K-INTERNATIONAL *Packings*

GRATON AND KNIGHT

LEATHER — SYNTHETIC RUBBER

P-6

GRATON & KNIGHT COMPANY, Worcester, Massachusetts
INTERNATIONAL PACKINGS CORPORATION, Bristol, N. H.

Applications Received

continued

Cincinnati Section

Grady W. Bowers, Jr., Harry B. Dorman, Lloyd B. Harper, D. Q. Marshall, Hillard W. Paige, Louis J. Thieken.

Cleveland Section

James P. Galm, George H. Gates, Gregory B. Gilmore, Bruce E. Hutchins, Everett Marra, Leo E. Novak, Frank L. Raggi, William Speicher, Walter P. Wright.

Chicago Section

Peter D. Aravosis, Earle S. Batchelor, Henry Berolzheimer, Jose G. Caero, Sidney F. Graham, Gordon L. Hershman, Edward F. Jolyk, James W. Leeming, Jr., Douglas George Lytle, Robert R. O'Donnell, Donald G. Sprigings, Robert W. Washington.

Colorado Group

Norman A. Olson, Orie J. Stemen.

Dayton Section

Lawrence M. Olson

Detroit Section

Robert E. Annis, Bruce A. Allen, John H. Baer, Clarence C. Bartell, Armand J. Bilitzke, William E. Bishop, William E. Chevalier, Thomas J. Cribbs, Daniel J. Czolgosz, Walter S. Fagley, Jr., Lawrence R. Green, Donald G. Harter, Duke S. Johnson, Clyde E. Juntunen, Alonzo H. Kelly, Jr., Richard P. Krygowski, Edward A. Macholl, Michael Master, George W. Michel, Dale O. Miller, Elroy E. Newlon, Robert E. Osborne, Robert W. Overman, Peter P. Parsons, Benjamin B. Phelps, William E. Powell, Carl Reynolds, Robert W. Richardson, Fred Sherman, Robert H. Skingley, George P. Smith, Burrowes G. Stevens, Jr., Kenneth E. Thorp, Alphonse C. Van Ermen, Bryon D. Waters, John B. Whitehouse.

Hawaii Section

John F. Cross, David A. Gowans, Lawrence R. Pestal, Elmer R. Williams.

Indiana Section

Charles R. Boll, Jr., Theodore G. George, Russell J. Limer, Arthur B. Lathrop, Lawrence P. Mamos, M. V. Van Kirk.

Kansas City Section

W. C. Broyles.

Metropolitan Section

James H. Cain, Snowman W. Doe, William J. Frick, Richard J. George, Carlton S. Kelly, Herbert C. Kiesling, William H. Peters, Lawrence Howard Rosenthal, William H. Scott, Charles J. Wilde.

Mid-Michigan Section

Stanley H. Swift, Robert J. Grills, John E. Kersten, Dimitar Toschkoff.

Milwaukee Section

Peter D. Humleker, Jr., Robert W. Lange, John C. Merker, Eugene L. Nelson, Alfred A. Stendel.

Mohawk-Hudson Group

Chace R. Sherman, James E. Sowash.

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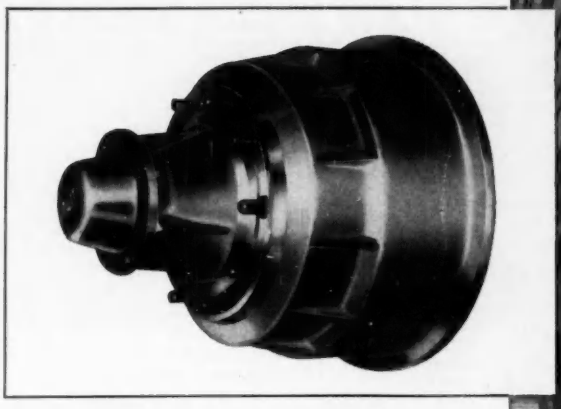

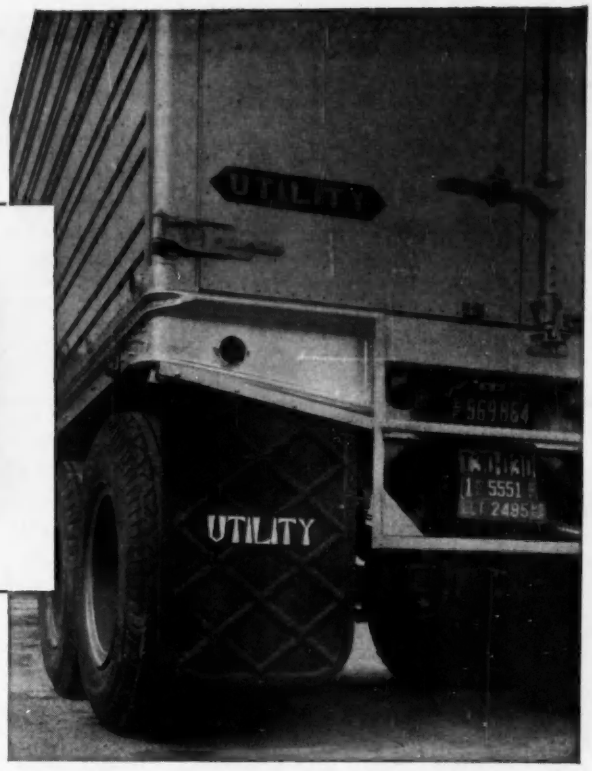

2% NICKEL CAST IRON BRAKE DRUM . . . designed to increase actual amount of braking surface. Cooler operation from reduced pressure per square inch, results in longer lining life and, obviously, safer operation. Produced by Utility Trailer Manufacturing Co., Los Angeles 54, Calif.

Meet a Superior Brake Drum

. . . Nickel cast iron that beats heat and wear

On steep mountain grades . . . or in the desert's heat . . . or in stop-and-go city traffic . . .

Brake drums on Utility trailers do more than resist shock, abrasive wear and galling.

Utility Trailer Manufacturing Company demands drums made of an iron that resists intense frictional heat from restricted surfaces no matter how long or steep the grade. The metal must resist distortion and heat-checking under all kinds of adversities.

And to make sure their drums have this combination of properties, the company's engineers specify the castings in 2% nickel cast iron.

Utility has used nickel cast iron for years. In fact, they developed their long-lasting brake drums to take full advantage of the improved properties of this alloy.

Hundreds of users have written unsolicited letters in praise of the Utility 10″ brake. For instance, A. W. Hays of Hays Trucking Company, Woodland, California, wrote:

> "In my fleet of trucks and trailers I have thirty-two Utility trailers. My drivers think these trailers have the best brakes of any trailers they have ever pulled. The maintenance cost is very low, some of the trailers have gone over 250,000 miles and the brakes do not need relining."

Utility's brake drums exemplify only *one of many* combinations of properties offered by nickel cast irons. Your own needs may call for a different combination. Investigate how the right type of nickel iron may improve *your* products or equipment. Full information is yours for the asking. Send the coupon now.

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Please send me booklet entitled "Guide to the Selection of Engineering Irons."

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City_____ State_____

THE INTERNATIONAL NICKEL COMPANY, INC. 67 WALL STREET NEW YORK 5, N.Y.

Applications Received

continued

Montreal Section

William J. Riley, Percival J. Waite.

Northwest Section

Robert B. Waggoner.

Oregon Section

Sam A. Battaglia, Richard Farnsworth, Arthur J. Trachsel, Stephen E. Wright.

Philadelphia Section

Edward L. Dold, Kay A. Estes, Robert G. Hardin, Alexander D. Kidd, Alexander A. Mittenbergs, Ray H. Moore, William E. Schluter, Jim S. Takasugi.

Pittsburgh Section

Chalsmer K. Brown.

St. Louis Section

Harvey S. Gershenson, Ray E. Kessler, Clifford A. Statler.

San Diego Section

C. Stewart Brandt, Wesley Hodgetts, R. W. Macomber, Lewis K. Pratt, Donald E. Roberts, Allen L. Smith.

Southern California Section

Donald J. Brewster, Read B. Chilcoat, Lon A. Fleener, George H. Fox, Jr., James R. Funderburk, John C. Grafton, Daniel R. Huston, Harold F. Kruzan, F. H. Markley, Donald J. Murphy, John S. Ogle, Herbert M. Palmtag, Robert F. Peterjohn, Wallace J. Petersen, Gerard F. Waller.

Southern New England Section

M. Andrew Melnick, Donald B. Weir.

Texas Section

Lawrence N. Bass, Ben L. Chouteau, Edward Enns, George E. Knudsen, Ernest R. Opley, Joe Willmon.

Texas Gulf Coast Section

Leon Blagg, J. B. Godwin, Jr., Mark K. Wallach.

Twin City Section

John C. Bandli, James F. West, Kamil Yigit, Willis S. Zeigler, Jr.

Western Michigan Section

William I. Barnes, Harvey A. Matthews, Owen D. Premo

Williamsport Group

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Foreign

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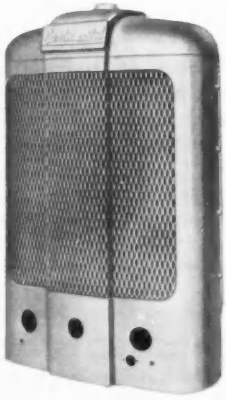
TERMINAL ISLAND in Los Angeles Harbor has been sinking at an alarming rate, and it is estimated that by 1965 the entire island will have slipped beneath the surface. To delay this sinking, and to protect huge industrial plant investments on the island, giant pumps have been installed within the dikes surrounding the plant to take care of the seepage. And these engine driven pumps, on which so much depends, are equipped with Yates-American Heavy Duty Radiators. If you are confronted with a similar problem, call on Yates-American to come up with the correct answer in dependable radiator equipment.



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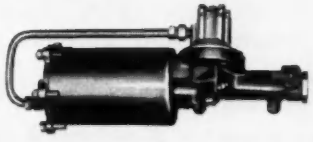
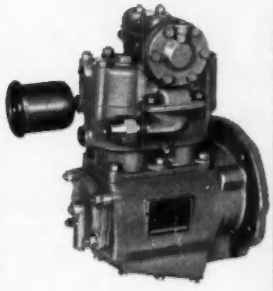
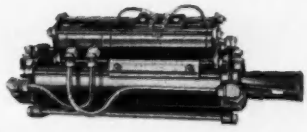
Midland Vacuum Hy-Power—for many years the choice of truck and bus operators and now available for passenger cars — converts ordinary hydraulic brakes into *power brakes*. Simple to install, compact, rugged construction, dependable. Positive braking under all conditions of road or weather.



Midland Air Hy-Power the original air-over-hydraulic power brake system—is still the finest, simplest, most dependable of its type. Provides air operation of tractor by hydraulic brake and control of trailer air brakes by standard hydraulic master cylinder. Lightning fast action, fewer parts, less weight. Sealed against the elements.



Midland Air Compressors offer patented automatic inlet valves built into the cylinder head for greater efficiency, cleaner air, cooler operation, simpler installation. Available in 7.4 and Model 12 capacities. Provide ample reserve braking power for the worst traffic emergencies.



Midland's complete door control equipment for buses includes every type of valve, switch, signal and connection required for safe, dependable, efficient operation. Systems available in both Straight-Air and Electro-Pneumatic operation. For years the choice of leading bus manufacturers. Time-proved the best by every test!

Whether you're a manufacturer or an operator of automotive equipment, you'll profit by insisting that your power brakes, compressors, and door controls be made by Midland. Complete information by writing the factory or through contacting your nearest Midland Distributor.

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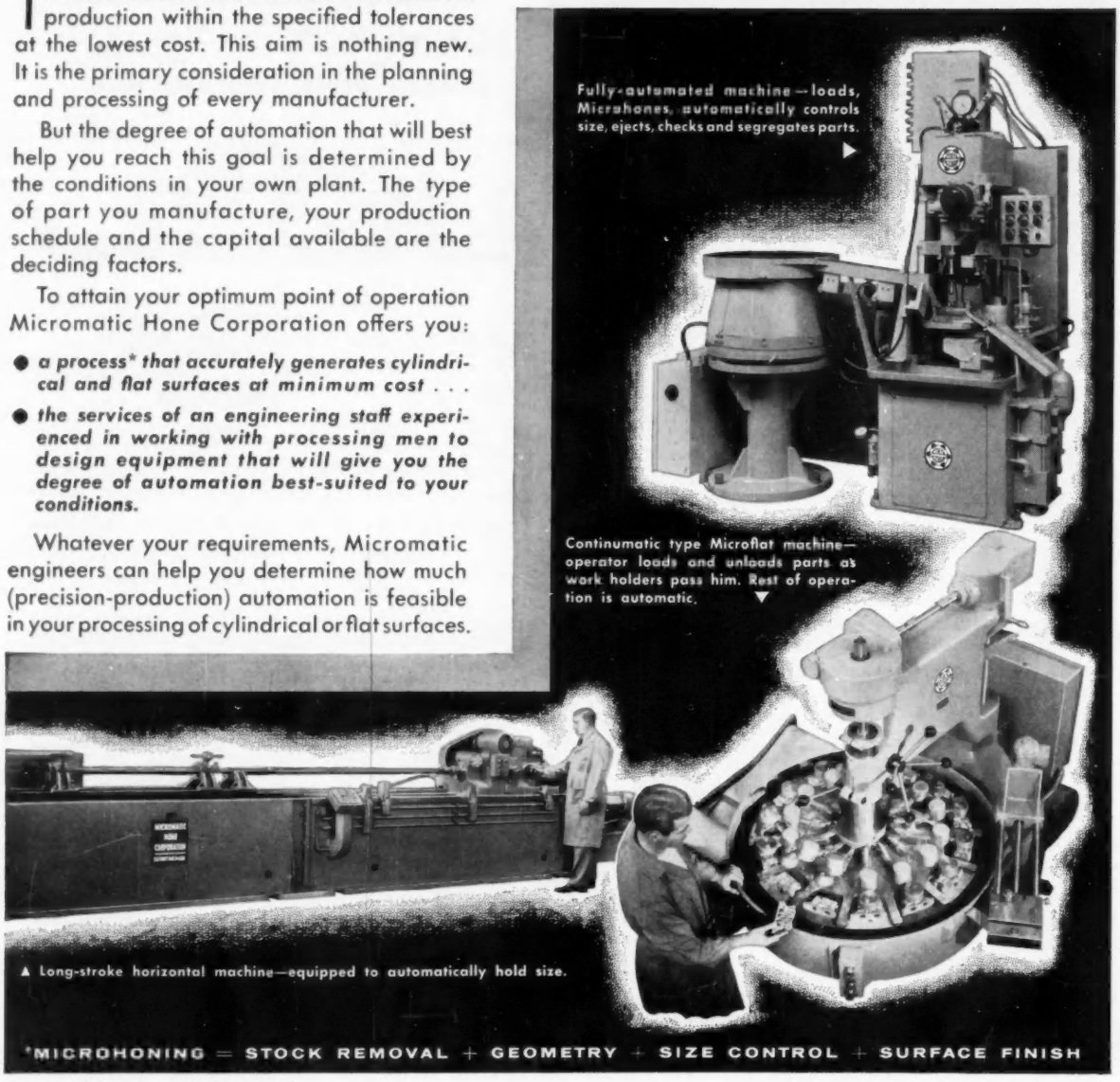
But the degree of automation that will best help you reach this goal is determined by the conditions in your own plant. The type of part you manufacture, your production schedule and the capital available are the deciding factors.

To attain your optimum point of operation Micromatic Hone Corporation offers you:

- ***a process* that accurately generates cylindrical and flat surfaces at minimum cost . . .***
- ***the services of an engineering staff experienced in working with processing men to design equipment that will give you the degree of automation best-suited to your conditions.***

Whatever your requirements, Micromatic engineers can help you determine how much (precision-production) automation is feasible in your processing of cylindrical or flat surfaces.



Fully-automated machine—loads, Microhones, automatically controls size, ejects, checks and segregates parts. ▶

Continumatic type Microflat machine—operator loads and unloads parts as work holders pass him. Rest of operation is automatic. ▼

▲ Long-stroke horizontal machine—equipped to automatically hold size.

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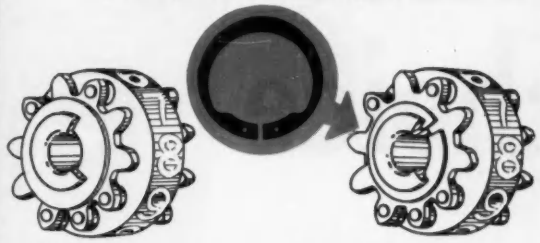
This is the Monroe Calculator

...precision-engineered business machine made even more efficient, and less costly to manufacture through the use of Waldes Truarc Retaining Rings.

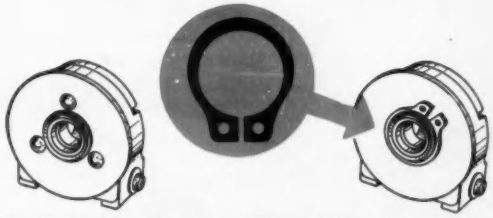
Multiplier Dial Assembly



Old Way. One-piece assembly was spun together. Spinning operation was costly, resulted in high scrap loss.

Truarc Way. Two-piece assembly is held together by one Truarc Ring (series 5108). Rejects: practically zero.

Electric Motor Governor



Old Way. Collector Disc assembly was formerly riveted, requiring skilled labor. Riveted Collector Disc could not be removed in the field.

Truarc Way. Truarc Ring (series 5100) replaces rivets, saves labor, material...improves Collector action. Collector Disc is easily replaced.

Intermediate Gear Shaft

Old Way. Washer riveted on end of assembly for zoning control. Costly, troublesome, hard to obtain critical zoning required.

Truarc Way. Truarc E-Ring (series 5133) cuts assembly time, virtually eliminates rejects and final assembly and zoning problems.

Monroe Calculating Machine Company, Orange, N. J. uses various types and sizes of Waldes Truarc Retaining Rings. Use of Truarc has helped eliminate scrap losses, saved on material and labor, and resulted in increased operating and servicing efficiency of the product. Monroe plans to use Truarc Rings for every possible fastening operation on their entire line!

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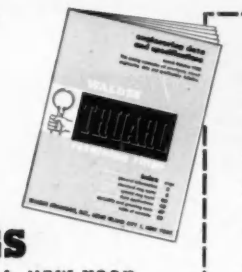
For precision internal grooving and undercutting...Waldes Truarc Grooving Tool!



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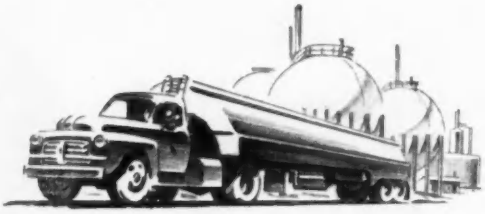

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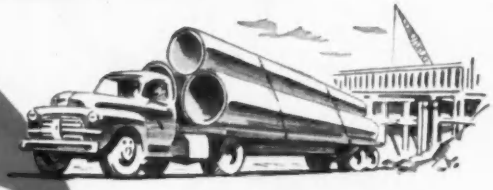

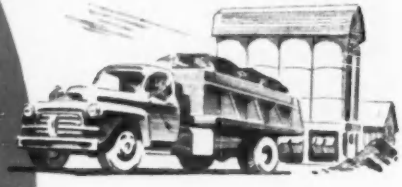

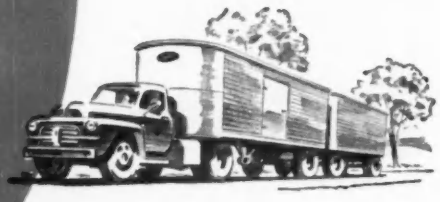

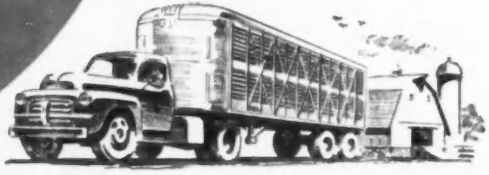

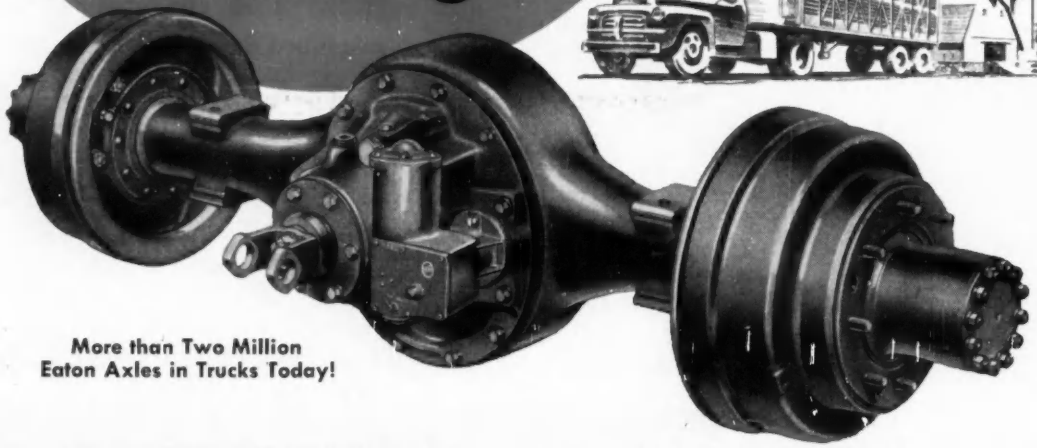

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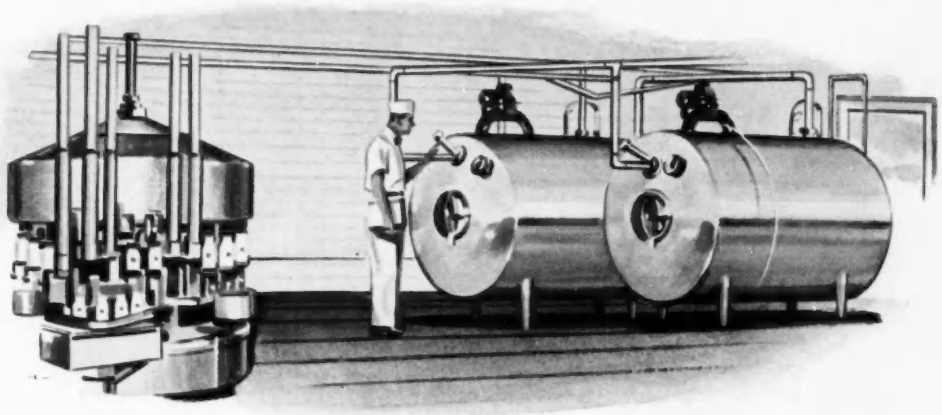

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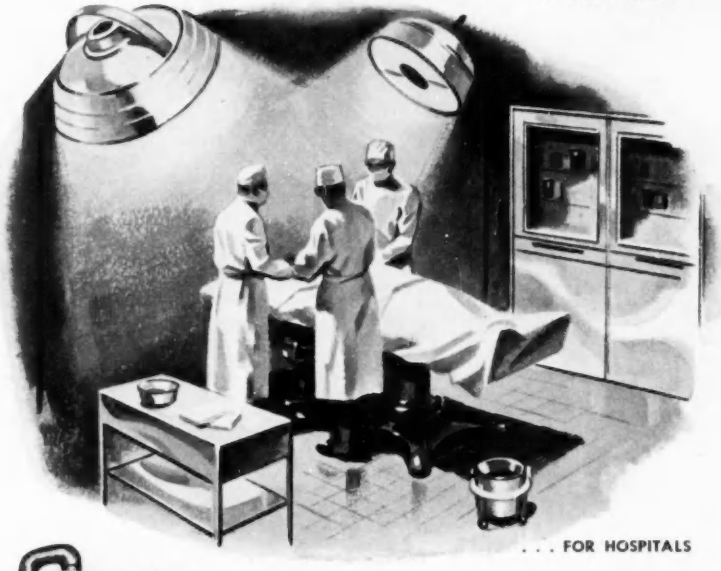

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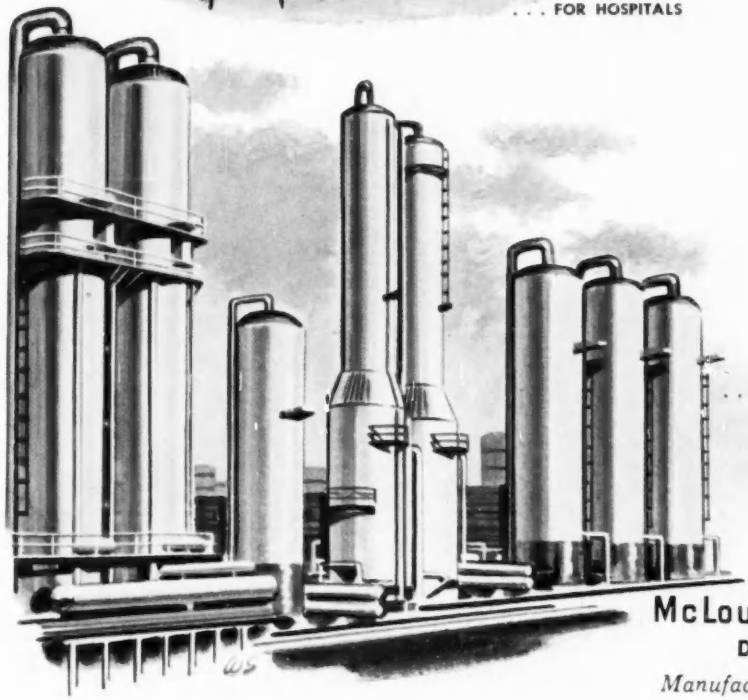

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High efficiency, small pulley diameters, fixed centers and a single belt instead of a multiple drive make PowerGrip a natural for dozens of automotive applications. United States Rubber Company engineers will gladly work with any automotive manufacturer who is interested in the great advantages of U. S. PowerGrip. Just phone us at Trinity 4-3500, Detroit, and ask for Mechanical Goods Division, or write address below.

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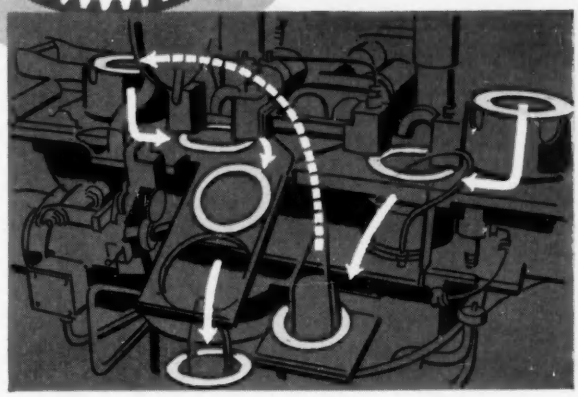

Better products at lower cost are usually the result of improved design *plus* improved processing. Take, for example, the clutch plates Moraine makes for automatic transmissions used in automotive vehicles. In the beginning each plate required many separate individual operations. Now these plates are fed into a specially designed automatic machine and completely processed with a great saving in labor costs. This specific example of the "forward thinking" at Moraine benefits both you *and* your customer.

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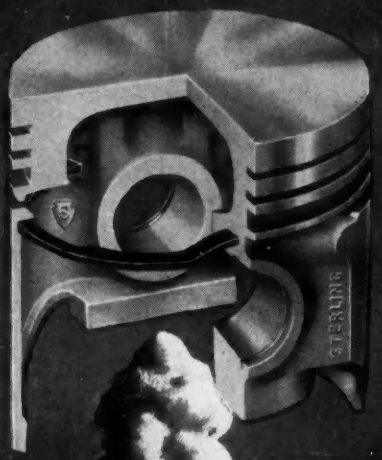

Now Allows You To Specify Your Own Piston Clearance!

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STERLING CONFORMATIC* PISTONS

Tests now prove that by varying the strength and design of the steel insert we can pre-determine piston skirt expansion and contraction to meet any engine clearance specification.

CONSTANT CLEARANCE over the entire temperature range from −20° F. to 200° F. Closer clearances than ever before possible without danger of scuffing or seizing.

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Bundyweld performs faithfully in the hydraulic brake control system of these Caterpillar Diesel No. 112 Motor Graders.

Famed Caterpillar-built products use Bundyweld for vital tubing parts

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Bundyweld starts as a single strip of copper-coated steel. Then it's . . .

continuously rolled twice around laterally into a tube of uniform thickness, and

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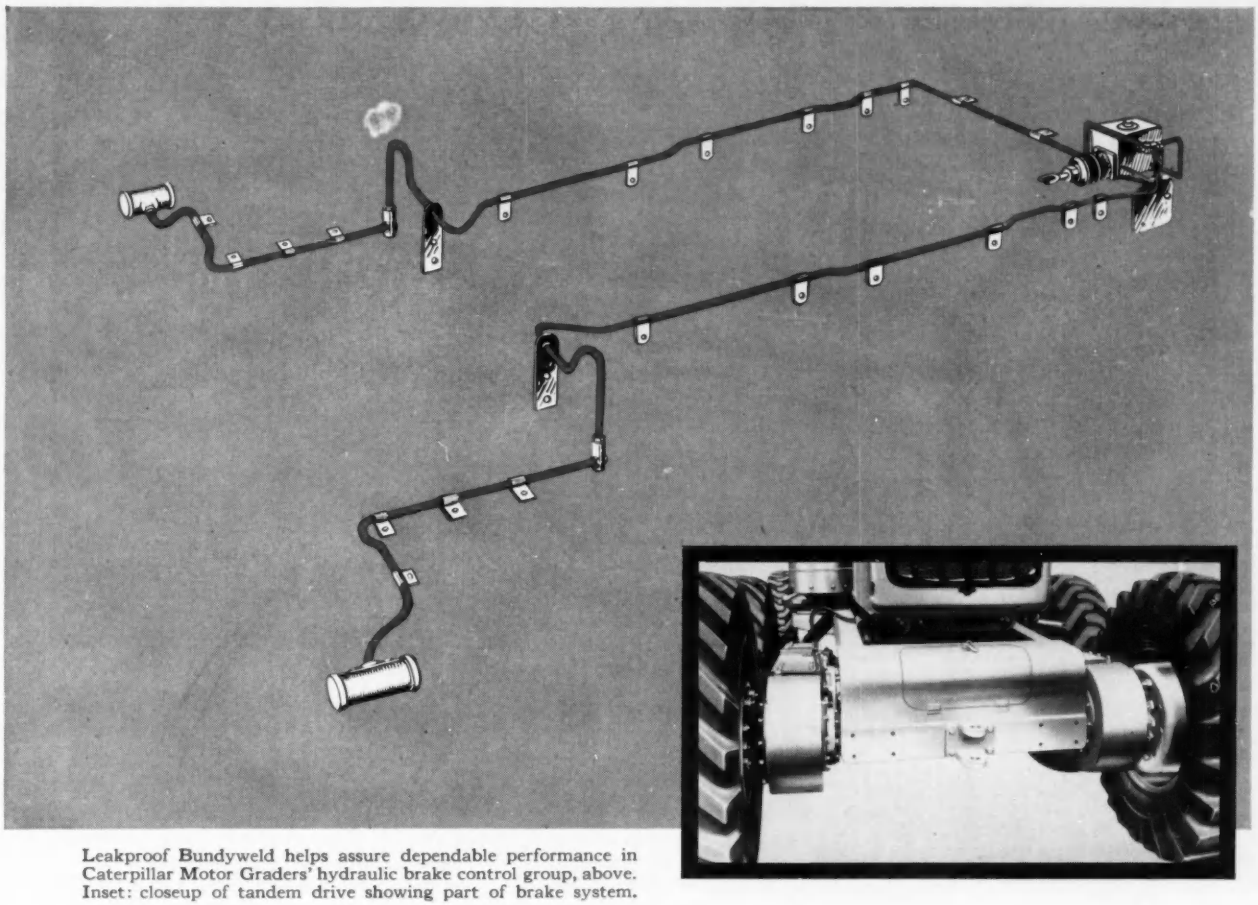
Bundyweld, double-walled and brazed through 360° of wall contact.

← NOTE the exclusive Bundy-developed beveled edges, which afford a smoother joint, absence of bead and less chance for any leakage.



Leakproof Bundyweld helps assure dependable performance in Caterpillar Motor Graders' hydraulic brake control group, above. Inset: closeup of tandem drive showing part of brake system.

On sea and on land, in forests or on farms, on construction projects around the globe – Caterpillar Tractor Co.'s powerful, dependable machines can be found, dynamic symbols of industrial progress.

One significant factor in Caterpillar's dramatic expansion has been the company's insistence on the reliability of its products. *That's why Caterpillar uses dependable Bundyweld Tubing for oil, brake, gas, transmission, other vital tubing lifelines.*

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Why not follow the example of the hundreds of industrial leaders who regularly use Bundyweld lifelines. Call, write or wire for data or for help with your tubing headache.

BUNDY TUBING COMPANY
DETROIT 14, MICHIGAN

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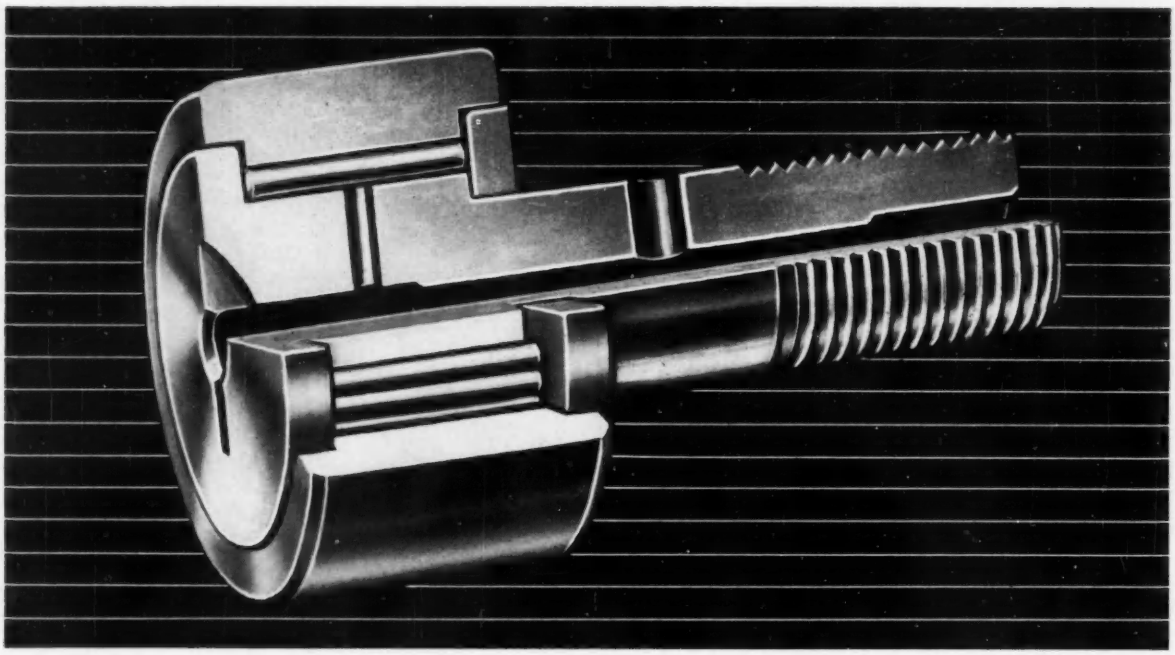
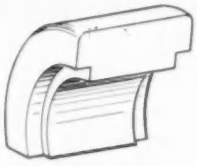
Bundy Tubing Distributors and Representatives: *Bridgeport, Conn.:* Korhumel Steel & Aluminum Co., 117 E. Washington St. • *Cambridge 42, Mass.:* Austin-Hastings Co., Inc., 226 Binney St. • *Chattanooga 2, Tenn.:* Peirson-Deakins Co., 823-824 Chattanooga Bank Bldg. • *Chicago 32, Ill.:* Lapham-Hickey Co., 3333 W. 47th Place • *Elizabeth, New Jersey:* A. B. Murray Co., Inc., Post Office Box 476 • *Los Angeles 58, Calif.:* Tubesales, 5400 Alcoa Ave. • *Philadelphia 3, Penn.:* Rutan & Co., 1717 Sansom St. • *San Francisco 10, Calif.:* Pacific Metals Co., Ltd., 3100 19th St. • *Seattle 4, Wash.:* Eagle Metals Co., 4755 First Ave., South • *Toronto 5, Ontario, Canada:* Alloy Metal Sales, Ltd., 181 Fleet St. East.
Bundyweld nickel and Monel tubing are sold by distributors of nickel and nickel alloys in principal cities.



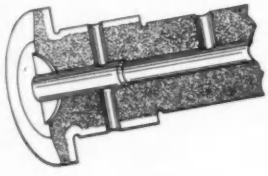
TORRINGTON CAM FOLLOWERS

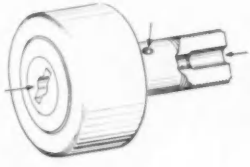
Give Longer Service... Carry High Shock Loads



1. Heavy sectioned outer race of hardened and ground high carbon chrome steel assures uniform distribution of high rolling and shock loads while providing high capacity anti-friction performance.

2. Integral stud for cantilever mounting is made of case hardened and ground low carbon nickel molybdenum steel. The tough core provides high strength to withstand high shock loads.

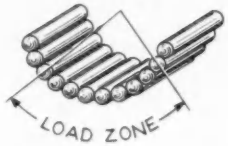


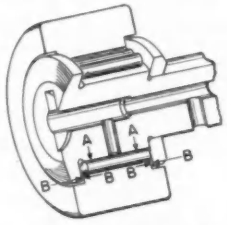


3. Easily relubricated at any one of three points—at either end or through cross hole in stud. Ends accommodate standard drive grease fittings, or may be sealed by the plugs provided.

District Offices and Distributors in Principal Cities of United States and Canada

4. Full complement of small diameter rollers—through-hardened, ground and lapped—for maximum radial load capacity.





5. Raceways precision ground for even load distribution (A) and uniform low end play (B) assure long bearing life.

Torrington Cam Followers are precision made throughout. They are available in sizes from ½" to 2¼" O.D. Special surface finishes such as chrome and cadmium plate or oxide black can be provided.

Our Engineering Department will be glad to work with you in adapting these dependable and efficient Cam Followers to your cam-controlled or track-type equipment. Torrington Cam Followers give better service because they're better made.

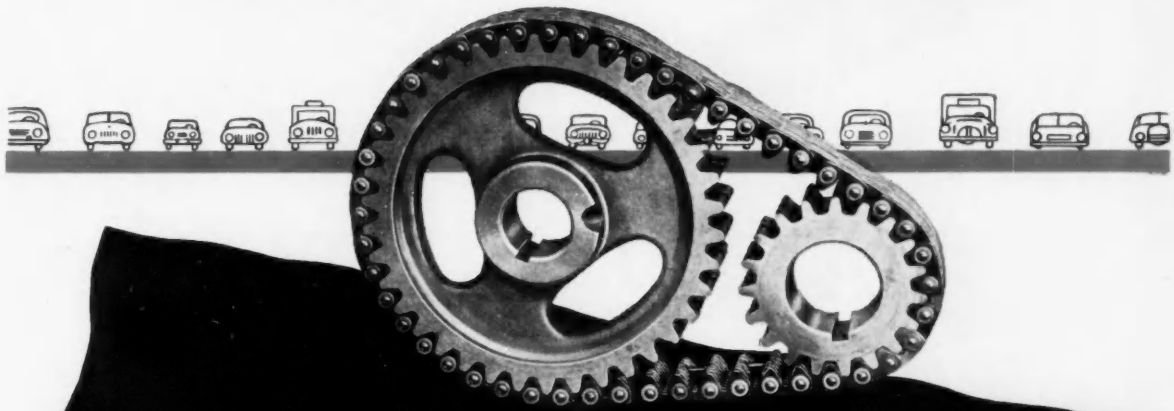
THE TORRINGTON COMPANY

Torrington, Conn. **South Bend 21, Ind.**

TORRINGTON *NEEDLE* **BEARINGS**

Needle • Spherical Roller • Tapered Roller • Cylindrical Roller • Ball • Needle Rollers

Among leading automotive manufacturers
the swing's to timing chain...



and LINK-BELT Timing Chain gives you these 3 BIG advantages

Segmental bushings provide automatic joint snugness

Segmental bushings are made with slight bow.

After initial assembly in chain, bushings are straight.

Bow in bushing acts to keep a snug joint.

1. Automatic joint snugness
2. Smoother operation
3. Longer life

YES, more and more new automobile engines are being designed for timing chain. And when it comes to timing chain—no other make can match Link-Belt's outstanding advantages. What's more, the tremendous facilities of the Link-Belt plant—the world's largest chain plant—assure you a dependable source. Our engineers will supply a test drive to your specifications. For full information, ask for Book 2065. 13.344

LINK-BELT

TIMING CHAINS and SPROCKETS

LINK-BELT COMPANY: 220 South Belmont Ave., Indianapolis 6, Ind. Offices in principal cities.

In the Spicer tradition

DANA CORPORATION

looks ahead
to another 50 years of progress

We are now starting our second 50 years of Spicer research . . . planning . . . development and advancement.

The beginning of this new Spicer era is sparked by a particular brand of courage. An inheritance of "git-up-and-go" from the pioneers who made the Spicer and Dana names world-famous:

CLARENCE W. SPICER, who invented and mass-produced the first universal joint for automotive vehicles.

CHARLES A. DANA, whose wisdom of decisions has welded together the big family of Spicer-Dana plants and products.

RALPH E. CARPENTER, who helped pilot the Spicer-Dana ship on a true course, through peace and war, through good times and bad.

Today, Spicer has available a 10-plant organization that embodies some of the most advanced efficiencies in the world. Spicer engineers are now on a program announcing a wide range of new and improved products. Many of these are revolutionary in performance. Spicer administration, sales and service have been sparked by new executives . . . new plans . . . *new action* in every department.

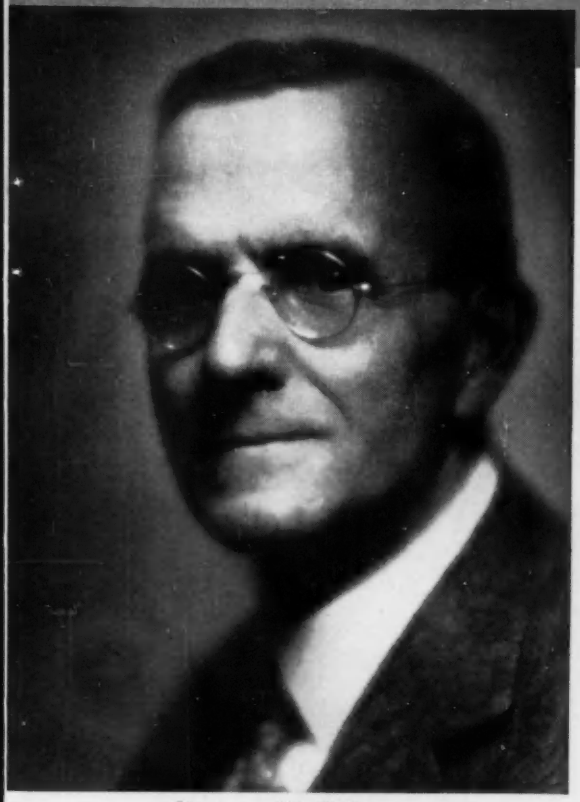
Action . . . that's what we promise you all along the line. *Action* . . . working together hand in hand with designers and engineers on vehicles of the future. *Action* . . . that will continue to develop power transmission units destined to further heighten the Spicer reputation as

"The Standard of the Industry"

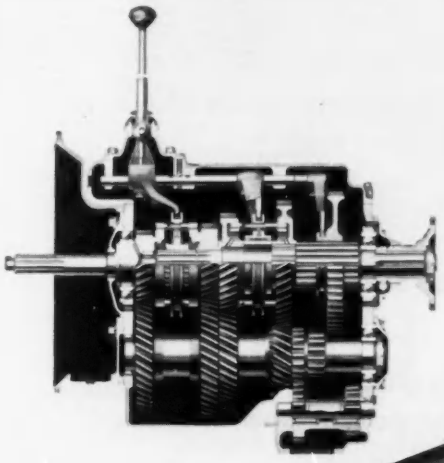
DANA CORPORATION • TOLEDO 1, OHIO

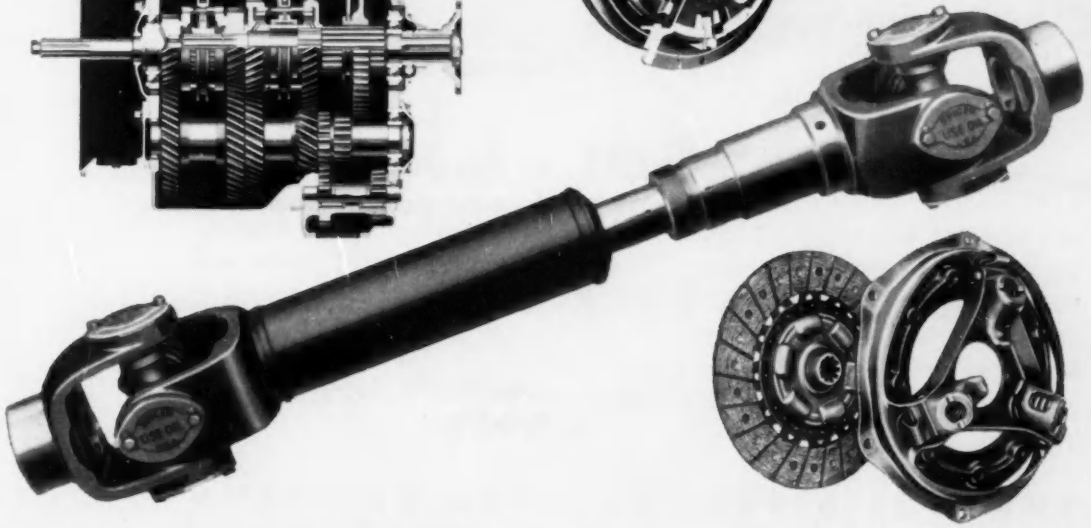
50 YEARS OF Spicer SERVICE

SPICER PRODUCTS: TRANSMISSIONS • UNIVERAL JOINTS • PROPELLER SHAFTS • AXLES • TORQUE CONVERTERS • GEAR BOXES • POWER TAKE-OFFS • POWER TAKE-OFF JOINTS • RAIL CAR DRIVES • RAILWAY GENERATOR DRIVES • STAMPINGS • SPICER and AUBURN CLUTCHES • PARISH FRAMES



Clarence W. Spicer





amp was first to develop and produce zig-zag spring seats of the no-sag type.

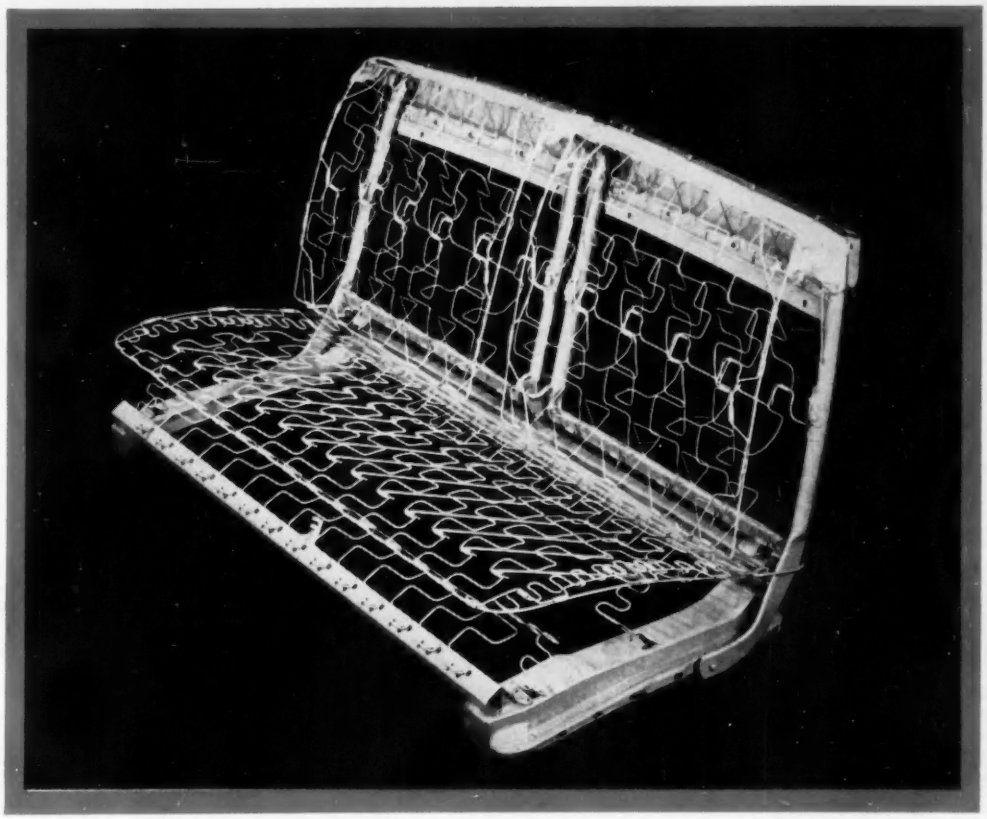
amp was first to develop and produce 1-piece torque tubes.

amp was first to develop and produce 4-way power seat tracks.

amp was first to develop and produce multiple-positioning manually operated seat tracks.

Formed Wire Spring

Developed, Patented and Produced by American Metal Products Company

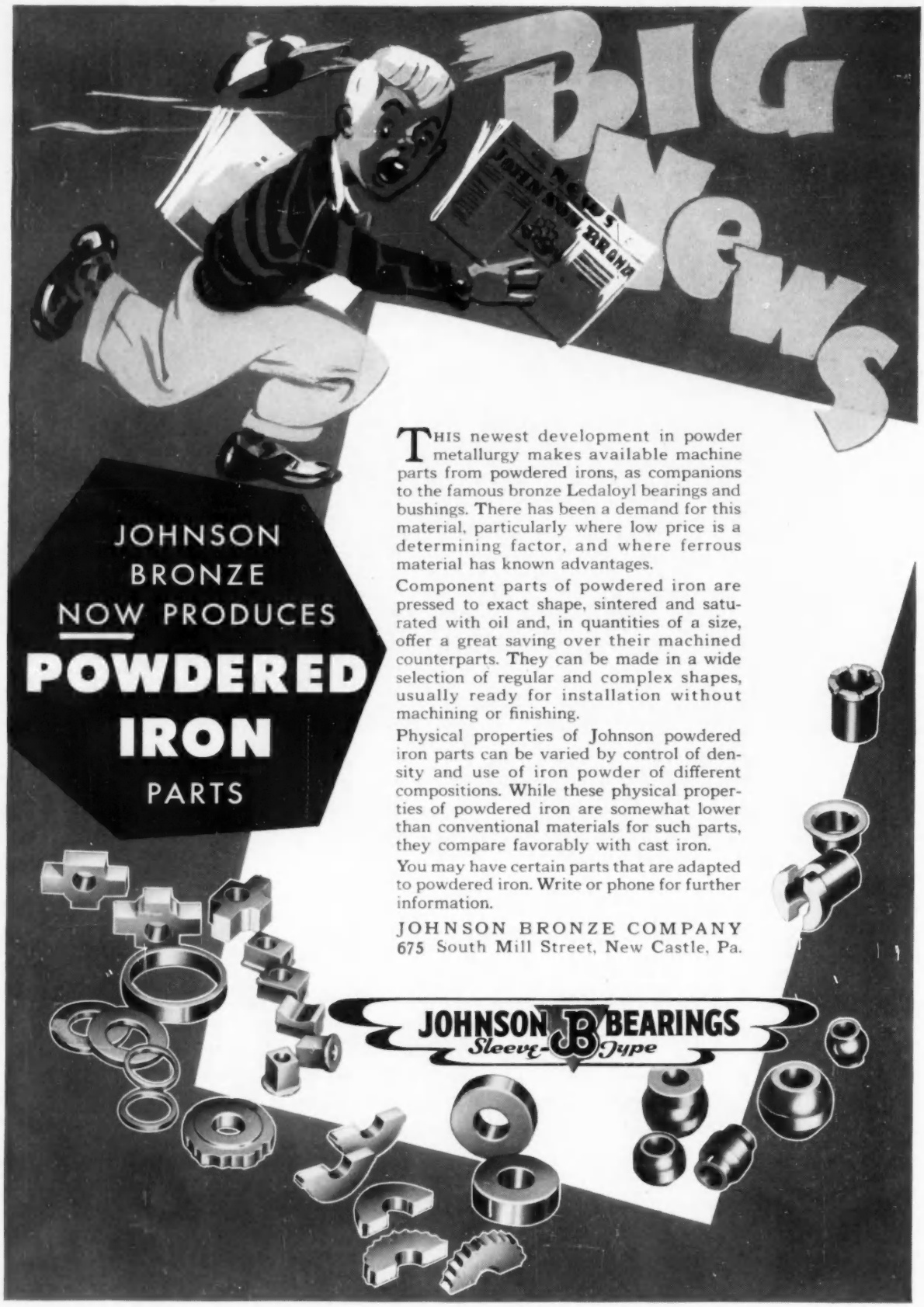


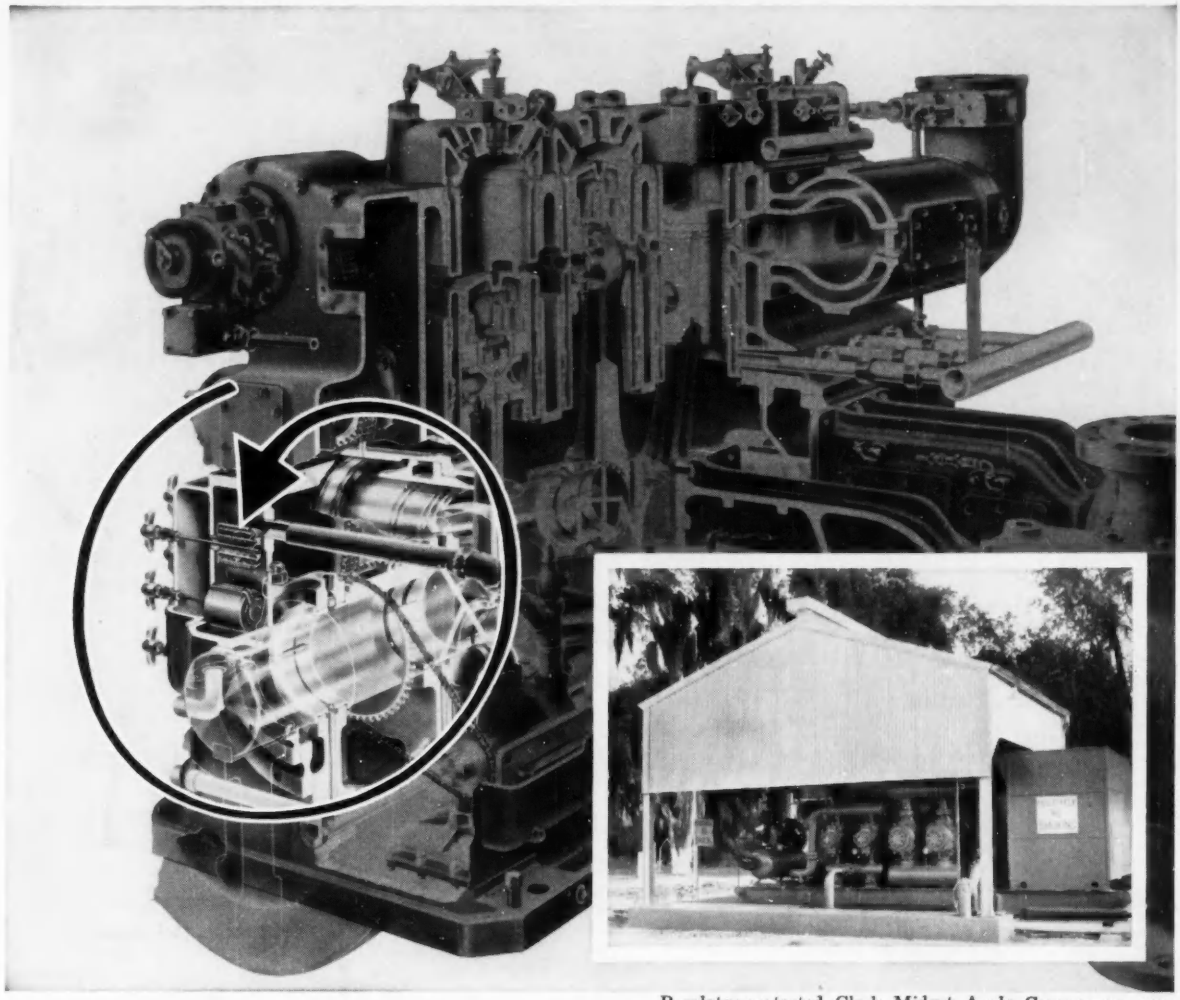
"Amazingly comfortable!" That's what you'll say when you relax on the new **amp** "Formed Wire Spring Seat Assembly". What's the secret? It's all in the strategic placing of the highest quality spring wire so as to distribute the stresses uniformly and provide maximum riding comfort. Because it has fewer parts and is produced on fully automatic equipment designed and patented by **amp,** this new spring costs less.

AMERICAN METAL PRODUCTS COMPANY

5959 Linsdale Avenue amp Detroit 4, Michigan

PLANTS • Detroit, Michigan • Kalamazoo, Michigan • Union City, Tennessee • Wallington, New Jersey


BIG
News
JOHNSON
BRONZE
NOW PRODUCES
POWDERED
IRON
PARTS
THIS newest development in powder metallurgy makes available machine parts from powdered irons, as companions to the famous bronze Ledaloyl bearings and bushings. There has been a demand for this material, particularly where low price is a determining factor, and where ferrous material has known advantages.
Component parts of powdered iron are pressed to exact shape, sintered and saturated with oil and, in quantities of a size, offer a great saving over their machined counterparts. They can be made in a wide selection of regular and complex shapes, usually ready for installation without machining or finishing.
Physical properties of Johnson powdered iron parts can be varied by control of density and use of iron powder of different compositions. While these physical properties of powdered iron are somewhat lower than conventional materials for such parts, they compare favorably with cast iron.
You may have certain parts that are adapted to powdered iron. Write or phone for further information.
JOHNSON BRONZE COMPANY
675 South Mill Street, New Castle, Pa.
JOHNSON B BEARINGS
Sleeve-Type



Purolator-protected Clark Midget Angle Compressor, gas-engine-driven. Skid-mounted for portability, Clark Compressor is a favorite for field gas gathering, gas lift, repressuring, flare gas elimination, pipeline testing and recycling plant feeders. Manufactured by Clark Bros., Co., Olean, New York.

Where does the DIRT *belong?*

OUTDOOR ENGINES, like outdoor boys, can't help getting dirty. But dirt will harm neither boys nor engines if steps are taken to get rid of it promptly!

In the Clark Compressor above, Purolator* Metal Edge Filters remove harmful combustion by-products and foreign matter entrapped in air or fuel lines supplying the engine. Purolator Fuel and Lube Filters . . . first line of defense against down time . . . are used on many other well-known "outdoor" engines, too.

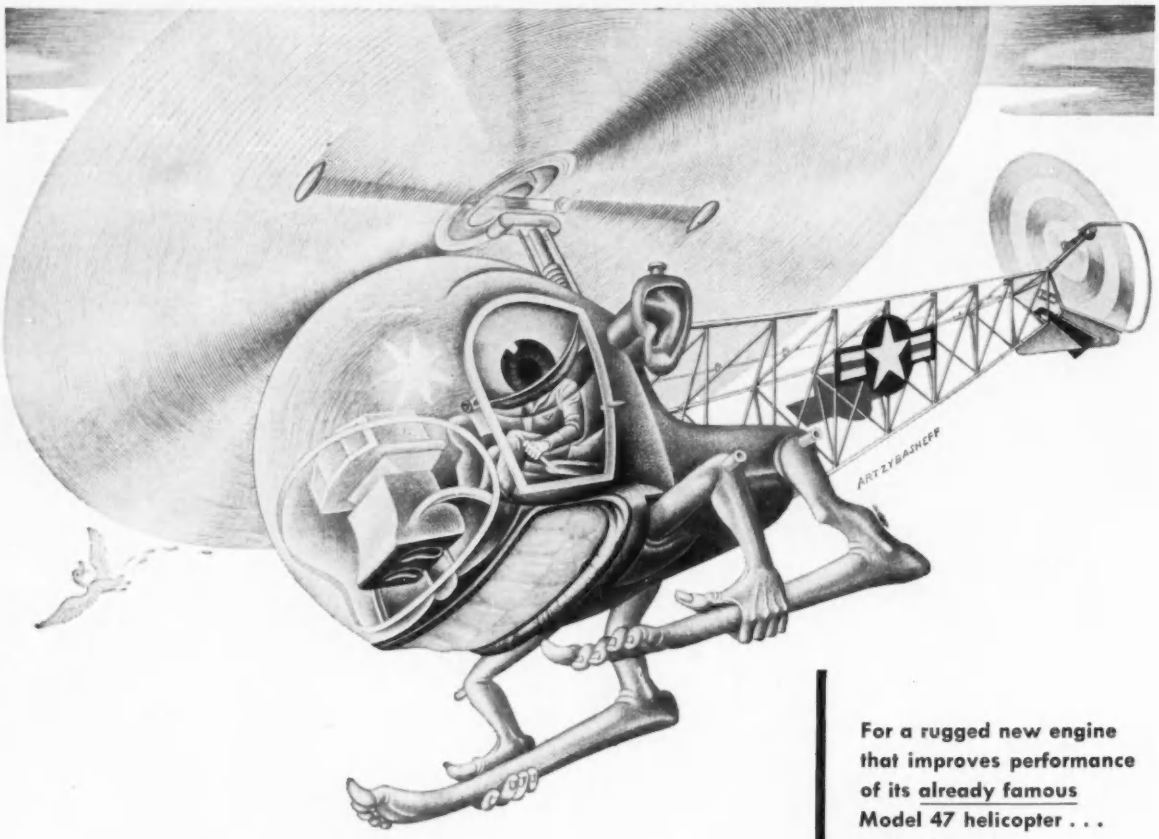
Purolator Metal Edge Fuel Filters—equipped with corrosion-resisting brass, monel or stainless steel elements—are available from ¼ in. to 15 in. diameter. Element spacing can be supplied to your requirements, from .001 in. to .025 in.

Write for the newest *Purolator Industrial Catalog*, your guide to the best in filtration equipment. Remember too . . . our Engineering Department will help you solve filtration problems, small or large.

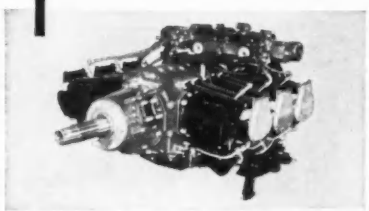
*Reg. U. S. Pat. Off.

PUROLATOR
WORLD'S FINEST OIL FILTER

PUROLATOR PRODUCTS, INC., Rahway, N. J., and Toronto, Ontario, Canada



For a rugged new engine that improves performance of its already famous Model 47 helicopter . . . and reduces maintenance as well . . . BELL looks to Lycoming.



New "vitals" for this Korean air vet

This battle-proven hero of 18,000 front-line rescues over Korea is now *outperforming itself*—newly powered by Lycoming's 250-h.p. O-435 engine.

With this superior power plant, both the Model 47 and its sister ship—the 4-Place Utility 47G-1—will fly faster and higher in all weather . . . and require far less maintenance.

Such performance improvement is but one of many Lycoming contributions to air-cooled power.

Can you use superior air-cooled power . . . or any other of the diversified services listed at the right of our signature? *Whatever* your problem . . . look to Lycoming!

Automotive and aviation engineers please note.

the Lycoming story

Send for Free Booklet! "THE LYCOMING STORY"... 40 interesting, illustrated pages showing many ways Lycoming is ready to help you. Write for it on your letterhead.

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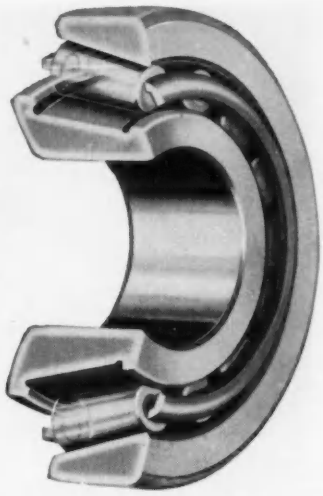
LOOK TO **Lycoming**

DIVISION OF AVCO STRATFORD, CONN.
Manufacturing plants in Stratford, Conn., and Williamsport, Pa.

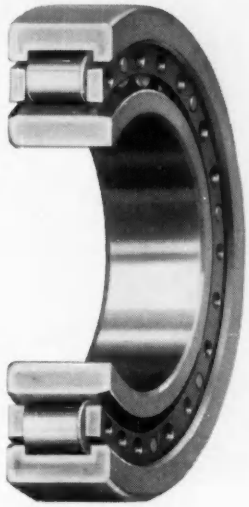
WHATEVER YOUR ROLLER BEARING APPLICATION

specify BOWER!



Earthmovers, jet turbine engines, rolling mill equipment, truck axles—you name it! Bower builds a complete line of tapered, straight and journal roller bearings including a size and type to fit *your* product. What's more, these dependable bearings have *proved* themselves in virtually every conceivable type of application. Their built-in quality, skillful engineering and advanced design features provide such important bearing advantages as reduced wear, longer life and lower maintenance requirements. Let a Bower engineer give you full details on the complete Bower line.

BOWER ROLLER BEARING COMPANY
DETROIT 14, MICHIGAN



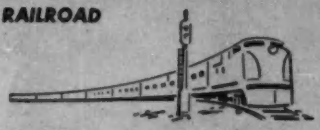
BOWER TAPERED ROLLER BEARINGS INCORPORATE ADVANCED SPHER-O-HONED DESIGN! Spherically generated roll heads and higher flange with larger, two-zone contact area reduce wear, improve roller alignment and virtually eliminate "end play." This helps hold adjustment and pre-load longer and better. Larger oil groove provides positive lubrication.

BOWER STRAIGHT ROLLER BEARINGS ARE BUILT TO CARRY MAXIMUM LOADS! Integral two-lip race increases rigidity—keeps rollers in proper alignment at all times. Steel cage allows free movement of rollers between races during normal operation. High-grade alloy-steel rollers and races are precision-ground for quieter, smoother operation.

A COMPLETE LINE OF TAPERED, STRAIGHT AND JOURNAL ROLLER BEARINGS
for every field of transportation and industry

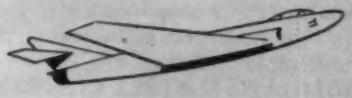
AUTOMOTIVE

RAILROAD



FARM

AIRCRAFT

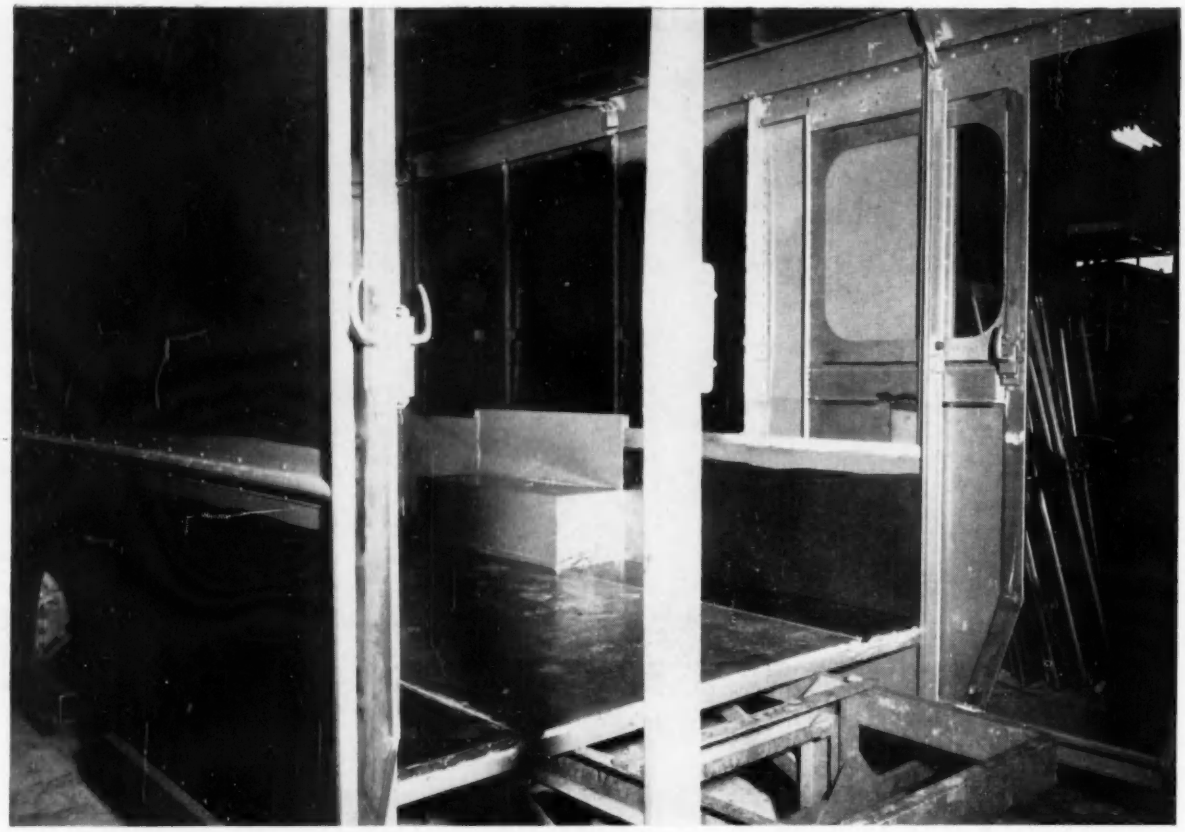


EARTHMOVING

INDUSTRIAL

BOWER
ROLLER BEARINGS

SPHERO-HONED



Mayari R frame members are welded into a single unit before Mayari R side sheets are riveted in place. High endurance limit of Mayari R is valuable in bodies which are subject to repeated loading, unloading and vibrations.

Boyertown builds bodies 25 to 40 pct lighter with Mayari R

One of the pioneers of the walk-in body for retail trucks is the Boyertown Auto Body Company, Boyertown, Pa. Today Boyertown's line of delivery panels is the largest in the industry.

To make sure that Boyertown truck bodies are light in weight but strong, Boyertown makes good use of Mayari R low-alloy, high-strength steel. Because it has a yield point half again as high as structural carbon steel, they use Mayari R in lighter sections without sacrificing strength one bit. In this way they lower the body weight from 25 to 40 pct, depending on the type of body. In a typical case, a 2639-lb body was cut to 1885 lb, a reduction of nearly 30 pct.

This modern Boyertown body was built almost entirely with Mayari R low-alloy, high-strength steel.

Where frame members are welded together, Boyertown will tell you that they weld Mayari R as successfully as other materials, without special equipment or techniques. And they like Mayari R's superior ability to take battering, denting or abrasion. Mayari R will keep its paint job better, too—holds paint up to 80 pct longer, depending on the type of paint used.

In light trucks, heavy trucks, buses and tankers, Mayari R is proving its versatility. Our new Catalog 353 shows a wide assortment of motor-vehicle applications in which Mayari R is adding strength, holding down weight, or giving longer life in tough service. It's full of useful technical data too. For a copy, just get in touch with the Bethlehem office nearest you.

BETHLEHEM STEEL COMPANY

BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. Export Distributor: Bethlehem Steel Export Corporation

BETHLEHEM STEEL

Mayari R *makes it lighter... stronger... longer lasting*

Judge a Product by its Users

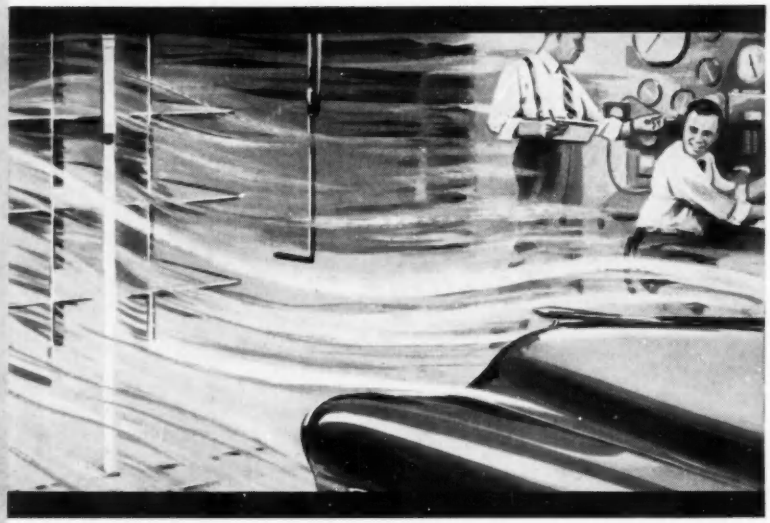
Used on the new Lockheed XFV-1 are two new Aeroquip developments . . . 617 lightweight air frame hose, and 601 lightweight engine hose with **"little gem"** fittings. The ready acceptance of these weight-saving products by leading manufacturers emphasizes Aeroquip's position of leadership in the field of aircraft plumbing.

Aeroquip

Aeroquip Corporation, Jackson, Michigan • Aero-Coupling Corporation, Burbank, California (*A subsidiary of Aeroquip Corporation*)

Local Representatives in Principal Cities in U.S.A. and Abroad. Aeroquip Products are fully Protected by Patents in U.S.A. and Abroad. **"little gem"** is an Aeroquip Trade Mark

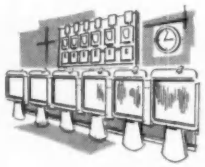
HOT or COLD...

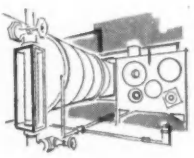


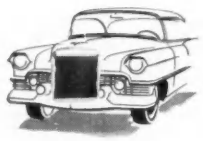
HARRISON HAS THE ANSWER!

Fiery heat or frigid cold—Harrison's in complete control! And we prove it . . . *in advance!* In Harrison automotive research laboratories, wind velocities range up to 100 miles per hour . . . temperatures from a bitter sub-zero to a scorching 100 degrees! Radiators, air conditioning systems, heaters and defrosters—all Harrison products are tested under the most punishing temperature conditions—*hot* or *cold!* That's why Harrison is a leader in its field—that's why so many manufacturers rely on Harrison exclusively for dependable, economical heat-transfer equipment! If *you* have a hot or cold problem, look to Harrison for the answer!

HARRISON RADIATOR DIVISION, GENERAL MOTORS CORP., LOCKPORT, N. Y.





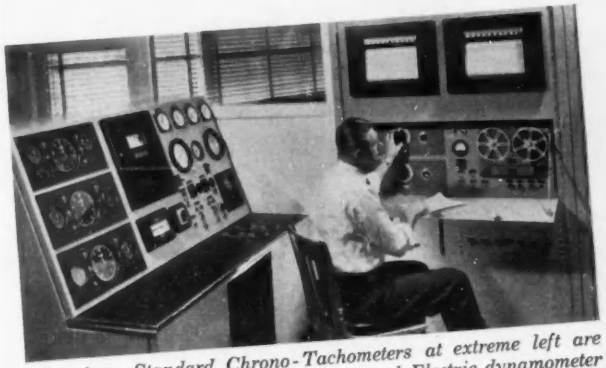


TEMPERATURES MADE TO ORDER

HARRISON

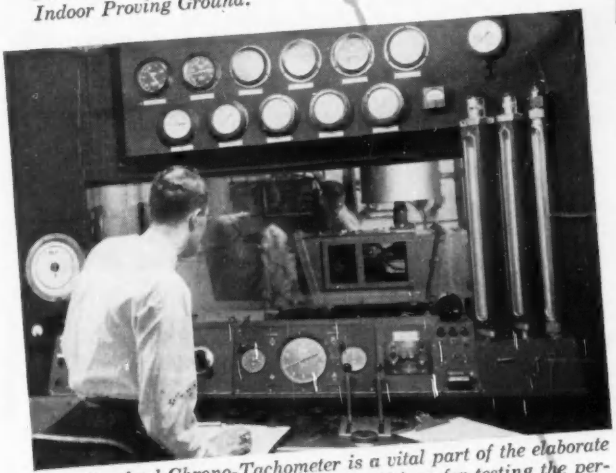
STANDARD CHRONO-TACHOMETERS

Serving industry, government, and educational institutions for over seventy years with fine precision instruments and equipment for the accurate measurement of time and for other testing purposes.



The three Standard Chrono-Tachometers at extreme left are part of the control system for the General Electric dynamometer installation at the Timken Detroit Axle Company's Alden Indoor Proving Ground.

At Sinclair Research Laboratories, Inc. this engineer is using a Standard Chrono-Tachometer mounted on the instrument panel of Sinclair's railroad diesel test engine, EMD-567B, used to develop and test lubricating oils.



The Standard Chrono-Tachometer is a vital part of the elaborate instrumentation needed to control conditions for testing the performance of fuels and lubricants, a most important function of Gulf Research — both for maintaining the quality of existing products and for developing new products.

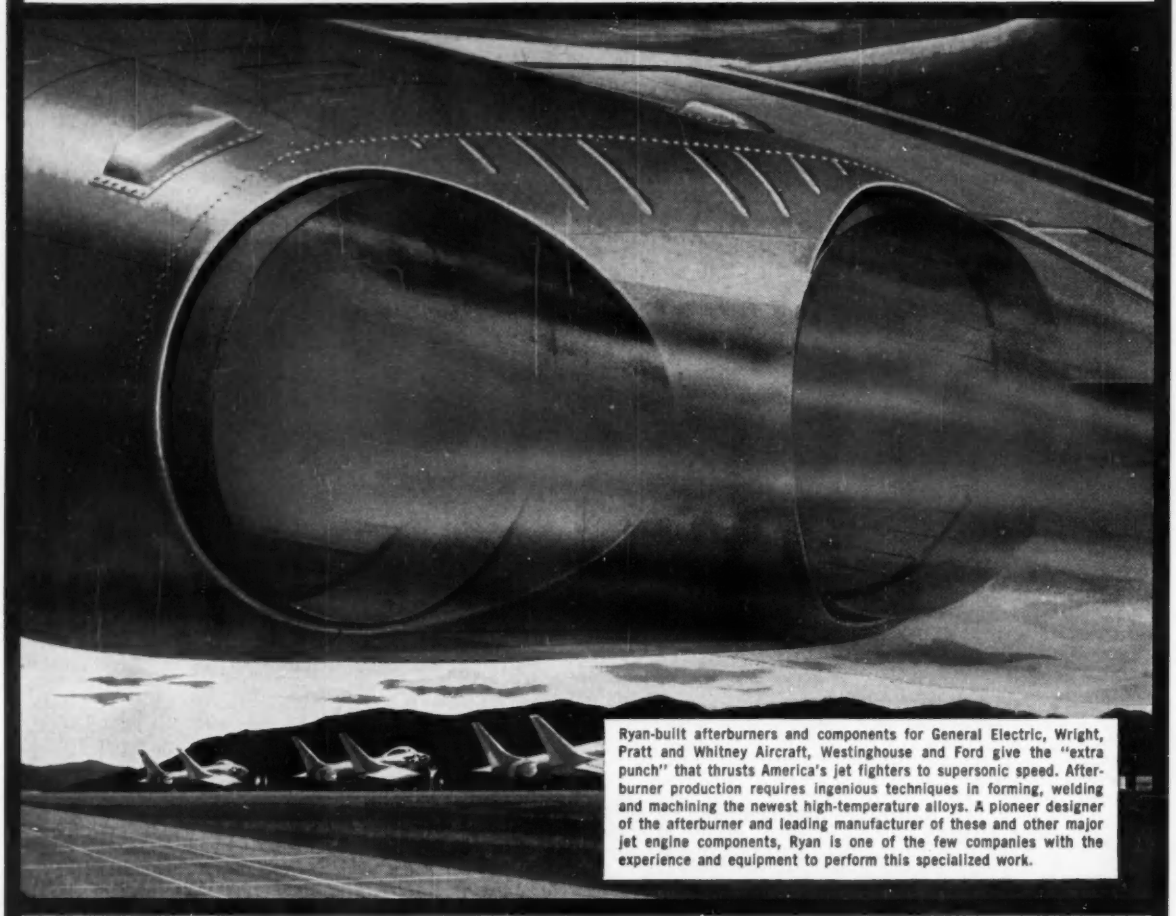
One of several Standard control consoles designed and built for the U. S. Navy, the above is used for testing aircraft generators. Note SG-6 Chrono-Tachometer used with 400 hp, 20,000 rpm prime mover.

THE STANDARD ELECTRIC TIME COMPANY *Since 1884*

87 Logan Street — Springfield 2, Mass.

PRECISION TIMERS • CHRONO-TACHOMETERS • LABORATORY PANELS • PIPELINE NETWORK ANALYZERS

RYAN AFTERBURNERS BLAST U.S. JETS AHEAD



Ryan-built afterburners and components for General Electric, Wright, Pratt and Whitney Aircraft, Westinghouse and Ford give the "extra punch" that thrusts America's jet fighters to supersonic speed. Afterburner production requires ingenious techniques in forming, welding and machining the newest high-temperature alloys. A pioneer designer of the afterburner and leading manufacturer of these and other major jet engine components, Ryan is one of the few companies with the experience and equipment to perform this specialized work.

Another Example of How

RYAN BUILDS BETTER

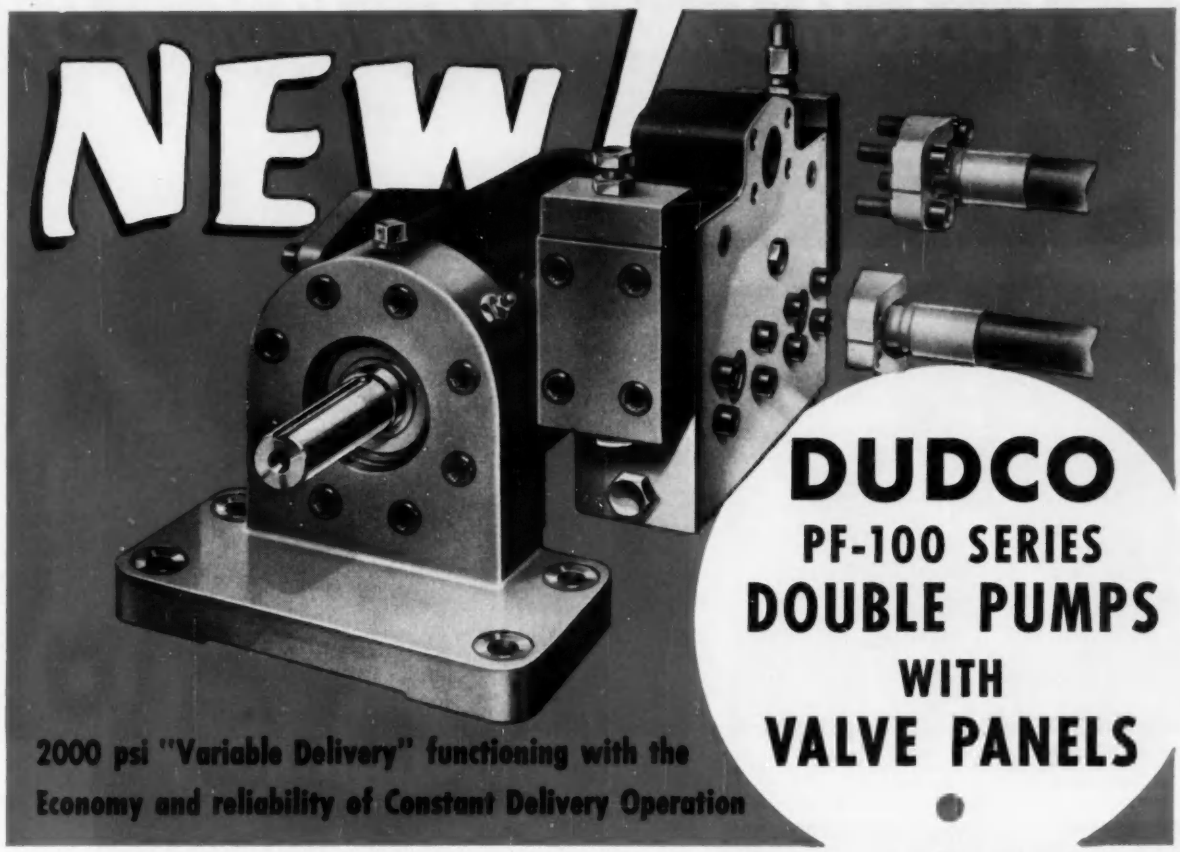
Because Ryan has tackled and licked the difficult, challenging jobs of the jet age, leading engine makers not only depend on Ryan for production of current models but also for new product development and initial manufacture of complex components for power plants of entirely new design. The only jet parts maker that also designs, builds and flies jet aircraft, Ryan has proven its ability to build to jewel-like precision the "hot parts" and major components for jet, piston, rocket and ramjet engines.

And in other fields, too – aircraft design, airborne electronics, drone missiles, basic research and development – Ryan has demonstrated the know-how which comes only from a background of 32 years in building planes and aeronautical products. Ryan's deserved reputation is built on producing only the best, delivering on time, and at minimum cost.

AIRCRAFT & COMPONENTS | AIRBORNE ELECTRONICS EQUIPMENT | AFTERBURNERS & JET COMPONENTS | PILOTLESS JET AIRCRAFT

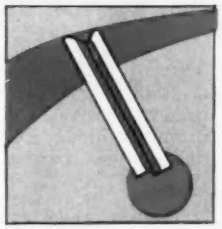
METALLURGICAL ENGINEERING | WEAPONS SYSTEMS | ROCKET MOTORS & RAM JETS | AIRCRAFT EXHAUST & DUCTING SYSTEMS

RYAN
AERONAUTICAL COMPANY
SAN DIEGO 12, CALIFORNIA



DUDCO PF-100 Series Double Pumps with Valve Panels are versatile. They furnish *Fluid Power*, at continuous pressures to 2000 psi, either to two separate systems or to a single two-pressure circuit, controlled automatically in response to working pressures or remotely thru a pilot line.

DUDCO PF-100 Series Double Pumps with Valve Panels assure top system economy. They can be installed with almost "plug-in" ease. The Valve Panel contains the elements necessary for pressure regulation and flow control . . . valves, piping and connections in a system are reduced.



TWO VANES ARE BETTER THAN ONE!

The hydraulically balanced DUAL-VANES in DUDCO Hydraulic Pumps as contrasted with conventional designs, maintain MULTIPLE AREAS OF CONTACT ON THE CAM RING . . . doubling the number of effective barriers to slippage and power loss. This patented principle is an exclusive DUDCO feature!

DUDCO Hydraulically Balanced, Dual-Vane Design Pumps give long, maintenance-free service at all pressures up to 2000 psi; with cost equal to that of low pressure pumps. DUDCO PF-100 Series Double Pumps with Valve Panels insure maximum circuit efficiency . . . only fluid required for effective circuit operation is pressurized. Wasteful by-passing of unneeded fluid is eliminated . . . horsepower is saved and fluid heating reduced. The regulator valves are internally piloted . . . this superior design allows more accurate adjustment and provides better control over a wider pressure range without the danger of spool sticking or over-pressurization.

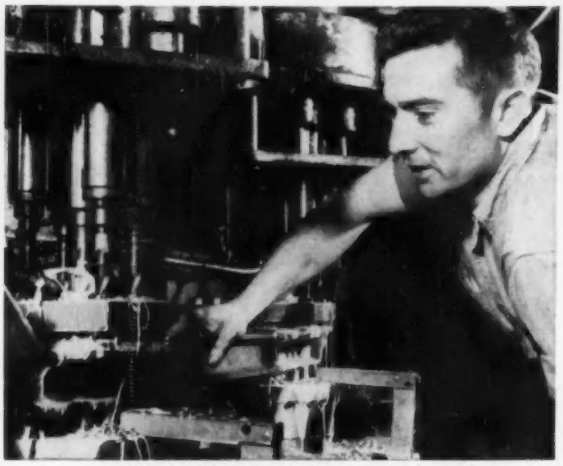
DUDCO DIVISION
THE NEW YORK AIR BRAKE COMPANY
1701 EAST NINE MILE ROAD • HAZEL PARK • MICH.

DUDCO DIVISION—
THE NEW YORK AIR BRAKE CO.
1701 EAST NINE MILE ROAD
HAZEL PARK, MICH.

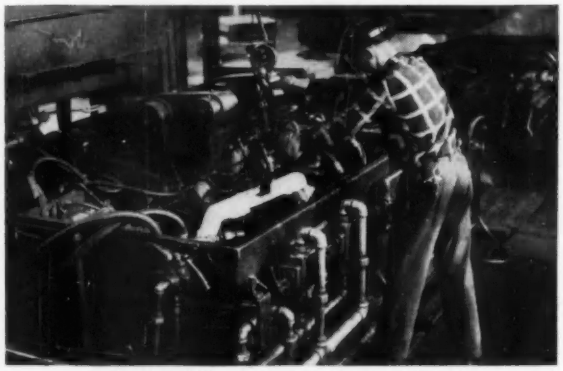
I would like more information about the DUDCO PF-100 Series Double Pumps with Valve Panels. Please send me Bulletin No. DP-308.

Name_____
Company_____
Address_____
City_____ Zone_____ State_____

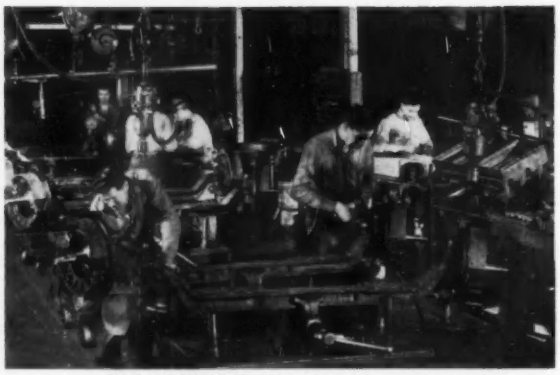
For trucks that must "roll until they die"



MULTIPLE SPINDLE DRILLING of 10 clip holes in the front axle spring pads. The particular CARILLOY Steel used for these parts has good strength and toughness, but is easy to drill and helps keep down tool costs.



FORGED AXLES are heated, quenched and tempered to obtain desired hardness and strength. CARILLOY Steel is easy to heat treat to the desired hardness.



FINAL ASSEMBLY of finished axles prior to painting and shipping. They will be used in heavy duty trucks that encounter severe off-road service. The necessary durability can be obtained only with a high quality alloy steel.

USS Carilloy Steel gives heavy-duty front axles needed strength, toughness, and impact resistance

FIRE trucks, garbage trucks, and municipal hauling equipment take a hard beating and must stay a long time on the job with minimum maintenance. Farm trucks and heavy-duty trucks used in mining and construction grind through mud, ruts, and open fields daily. Every part on this equipment has to be rugged . . . has to keep working continuously until the trucks are ready for the scrap heap. Rockwell Spring and Axle Company makes front axles for trucks like these; and to build in the needed durability, they use USS CARILLOY Steel extensively, not only for axles, but for steering knuckles and arms, steering knuckle pins, and steering arm ball studs. They use it everywhere that extra stamina is needed.

If your equipment must face up to severe service, if you want durability and resistance to abuse beyond the ordinary, specify USS CARILLOY Steels. You can get practically any combination of strength, toughness, and impact resistance . . . in a wide range of sizes, forms, and heat treatments . . . to *any* quality specification.

When you have any question about steel or its use, call in a USS Service Metallurgist for expert assistance.

UNITED STATES STEEL CORPORATION, PITTSBURGH · COLUMBIA-GENEVA STEEL DIVISION, SAN FRANCISCO
TENNESSEE COAL & IRON DIVISION, FAIRFIELD, ALA.
UNITED STATES STEEL SUPPLY DIVISION, WAREHOUSE DISTRIBUTORS
UNITED STATES STEEL EXPORT COMPANY, NEW YORK

Carilloy Steels

USS

ELECTRIC FURNACE OR OPEN HEARTH
COMPLETE PRODUCTION FACILITIES IN CHICAGO OR PITTSBURGH

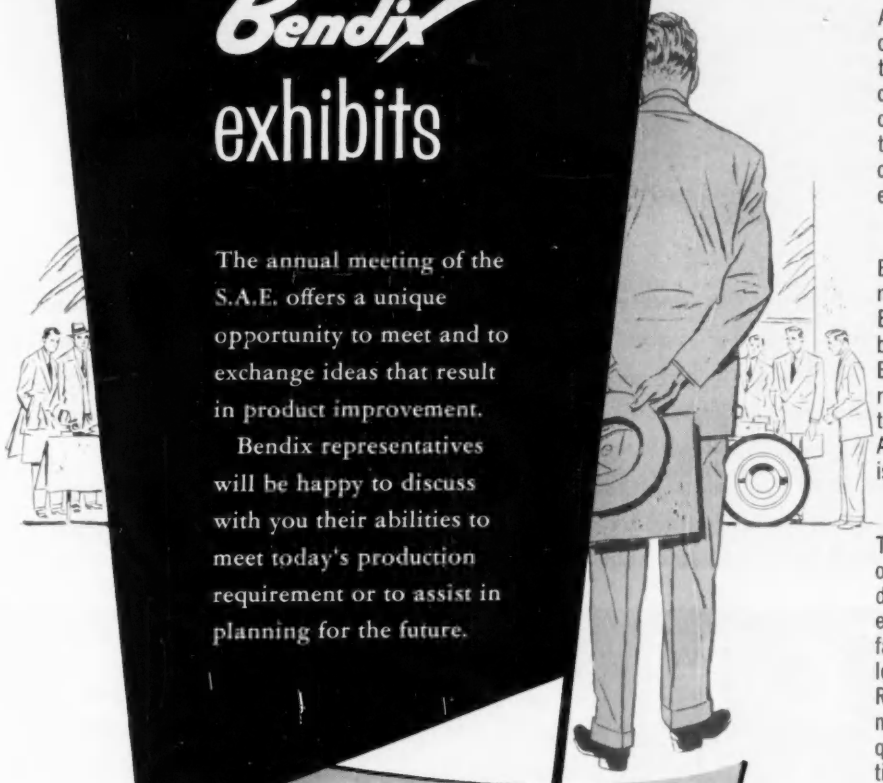
UNITED STATES STEEL

at the S.A.E. ANNUAL MEETING

be sure to see the Bendix exhibits

The annual meeting of the S.A.E. offers a unique opportunity to meet and to exchange ideas that result in product improvement.

Bendix representatives will be happy to discuss with you their abilities to meet today's production requirement or to assist in planning for the future.



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Space 38-39-40 Ballroom Floor

BENDIX PRODUCTS DIVISION

For a quarter of a century, Bendix Products has maintained leadership in all phases of automotive braking. Today the Bendix* Low Pedal Power Brake for passenger cars is the industry's first choice for standard equipment.

BENDIX-SKINNER DIVISION

Now located in a new and larger plant, the Bendix-Skinner Division has greatly increased its capacity to meet the industry's needs with over 350 types of filters.

SCINTILLA DIVISION

As the world's foremost producer of ignition equipment, the Scintilla Division is particularly capable of supplying high efficiency magnetos, battery ignition units, switches, electrical connectors and fuel injection equipment.

ECLIPSE MACHINE DIVISION

Eclipse Machine Division has manufactured over 100,000,000 Bendix* Starter Drives. Stromberg* Carburetors produced by Eclipse have contributed materially to automotive progress and the comparatively new Bendix* Automotive Electric Fuel Pump is already the leader in its field.

BENDIX RADIO DIVISION

The fact that Bendix* Radio not only is deeply engaged in production of all types of radio equipment, but is equally familiar with automotive problems as well, makes Bendix Radio the ideal choice for auto manufacturers interested in quality performance at production prices.

*REG. U. S. PAT. OFF.

THE NAME Bendix AVIATION CORPORATION MILLIONS TRUST

ACCURATE

From the largest bomber to the smallest helicopter MECHANICS Roller Bearing UNIVERSAL JOINTS *accuracy* has met every aircraft need. Designs, metals, machining, tolerances, heat treating, hardening, balancing and lubrication—all have been specifically adapted for aircraft precision. Let MECHANICS universal joint engineers help solve *your* control and power transmission problems. Our new catalog, containing helpful universal joint engineering data and tracing kits, will be sent to engineers, upon request.

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SMALL ELECTRIC MOTORS

to power—

WINDSHIELD WIPERS • SEATS • TOPS • HOODS • WINDOWS • VENTILATORS • STARTERS • HEATERS • TRANSMISSION AND AXLE MECHANISMS

Well built, with characteristic AMERICAN BOSCH precision quality, these high-torque small Motors are sturdy, quiet, powerful and dependable. Just a few of the good reasons they are already in wide use as original equipment. If you have one or a number of small motor requirements in your designs, put the problem up to American Bosch, Springfield 7, Mass.

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PISTON RINGS

Since 1910, McQuay-Norris has played a leading role in the piston ring field. This background of more than 43 years experience is available to manufacturers who require engineering and production skills of the highest standard.

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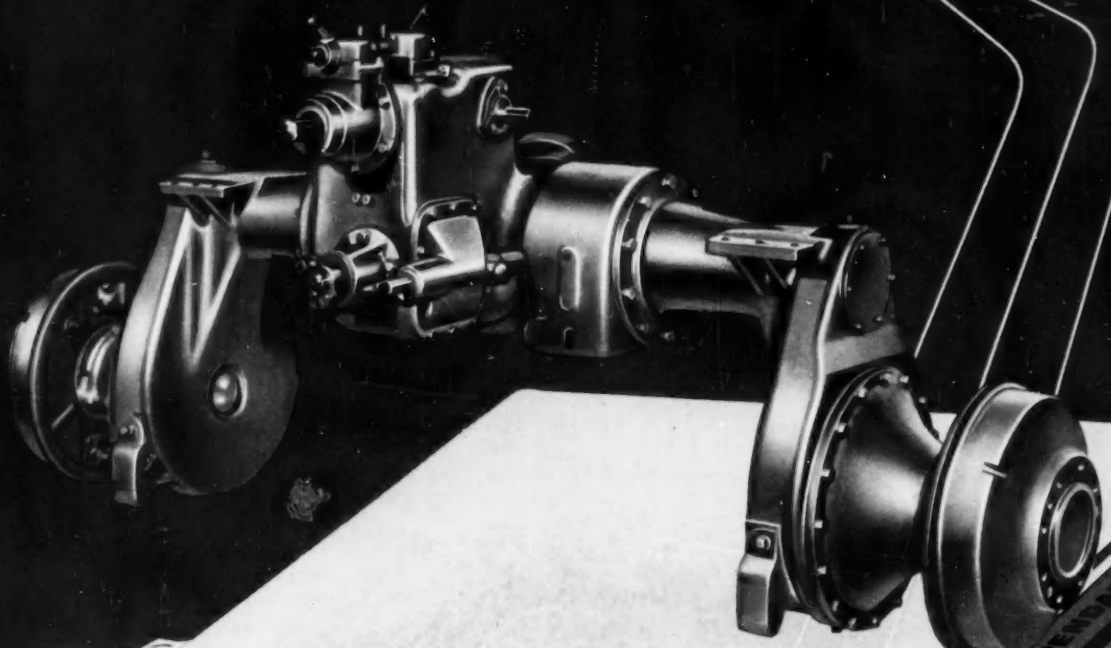
Rugged, efficient.....



THE CLARK AXLE TRANSMISSION

ACCURATE
DURABLE
EFFICIENT
DEPENDABLE
ECONOMICAL

Do you use PRECISION GEARS ? CLARK produces them ...MOST TYPES, MOST SIZES

Clark designed axle-transmission units with the ability to do an effective job—and at the same time absorb punishment—are one of today's best examples of "profitable cooperation." An outstanding example of why it's "good business" to do business with Clark.

CLARK* EQUIPMENT

*TRADEMARK OF THE CLARK EQUIPMENT COMPANY

CLARK EQUIPMENT COMPANY, BUCHANAN, Battle Creek, Jackson, Benton Harbor, Michigan

Nick Wright Motor Company, Norfolk, Va.

Chrysler parts distributor says:

"We doubled warehouse capacity, easily handle 50% more business with our Clark truck"

Nothing we can say will better explain the advantages of a Clark-handling system than this statement by Mr. C. S. DeHuff, Manager of the Parts Department, Nick Wright Motor Company, Norfolk, Virginia.

"By palletizing our MoPar inventory and installing rack structures, we have at least doubled the bulk capacity of our warehouse space with absolutely no structural change in the warehouse itself. Such palletizing, which is possible only through the use of the fork truck, has enabled us to eliminate 'can't find' items—the orderly arrangement of stock reduces mixups in part numbers. Stock can be readily located or inventoried at any time. We estimate that this system enables us to handle at least 50% more business with the same personnel."

How about your own inventory system?—any room for improvement in *your* volume or net? Why not talk to your local Clark dealer about the advantages of a Clark-handling system. It often pays off in big savings!

CLARK EQUIPMENT*

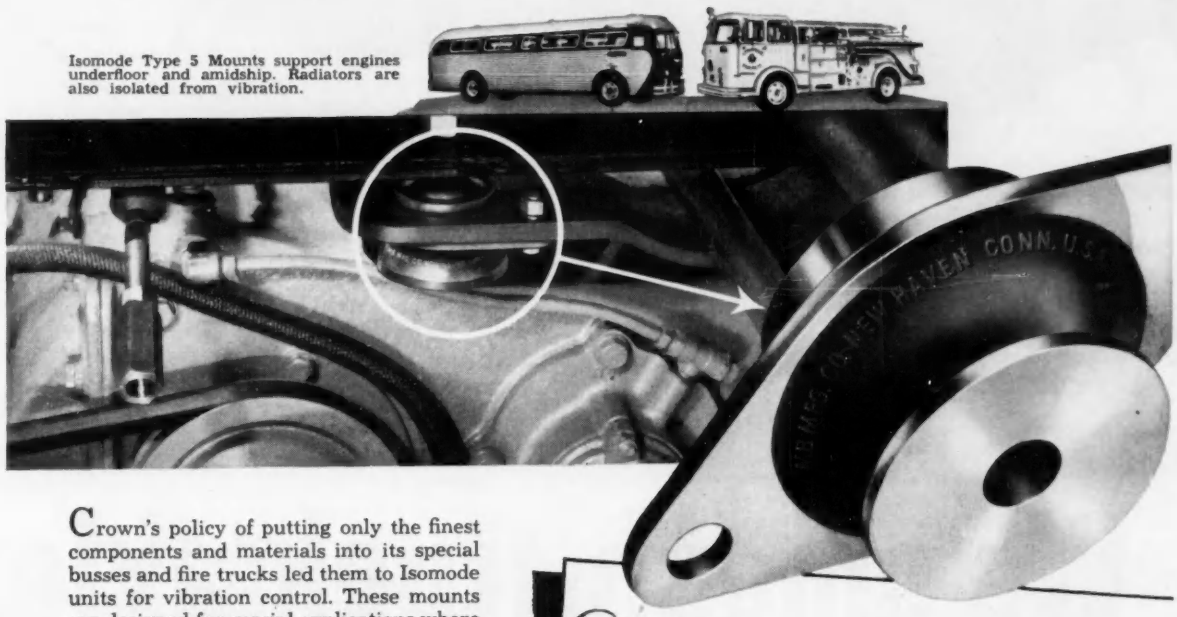
Industrial Truck Division
CLARK EQUIPMENT COMPANY
Battle Creek, Michigan

*TRADEMARK OF THE CLARK EQUIPMENT COMPANY

Your local Clark dealer is listed in the Yellow Pages. Ask him about Clark's low-cost Pay-As-You-Go leasing plan.

ISOMODE® MOUNTS "...absorb vibration to a remarkable degree"

in Crown busses and fire trucks



Isomode Type 5 Mounts support engines underfloor and amidship. Radiators are also isolated from vibration.

Crown's policy of putting only the finest components and materials into its special busses and fire trucks led them to Isomode units for vibration control. These mounts are designed for special applications where performance and quality count most. From experience, Crown's choice has proved "more than satisfactory." Isomode mounts not only are tough, durable, but also absorb vibration to a remarkable degree.

In the coaches, Isomode Mounts support Hall-Scott, International Harvester, and Cummins diesel engines in amidship, underfloor installations. They also isolate radiators. They also assure smoothness in the famous Crown fire trucks designed with cab ahead of axle.

These various installations illustrate the versatility of Isomode mounts. With their design principle of equal stiffness in all planes, they isolate vibration from all directions, and work at any mounting angle.

As a principal source for special-performance mounts, MB may have the answer to *your* special vibration control problem. Contact us and see.

®*Trade Mark Reg. U.S. Pat. Off.*

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For over a half century

MAIN EXECUTIVE AND SALES OFFICES
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LOS ANGELES 21, CALIFORNIA
TELEPHONE: TRinity 4021

September 17, 1954

The M B Manufacturing Company, Inc.
1060 State Street
New Haven, 11, Connecticut

Gentlemen:

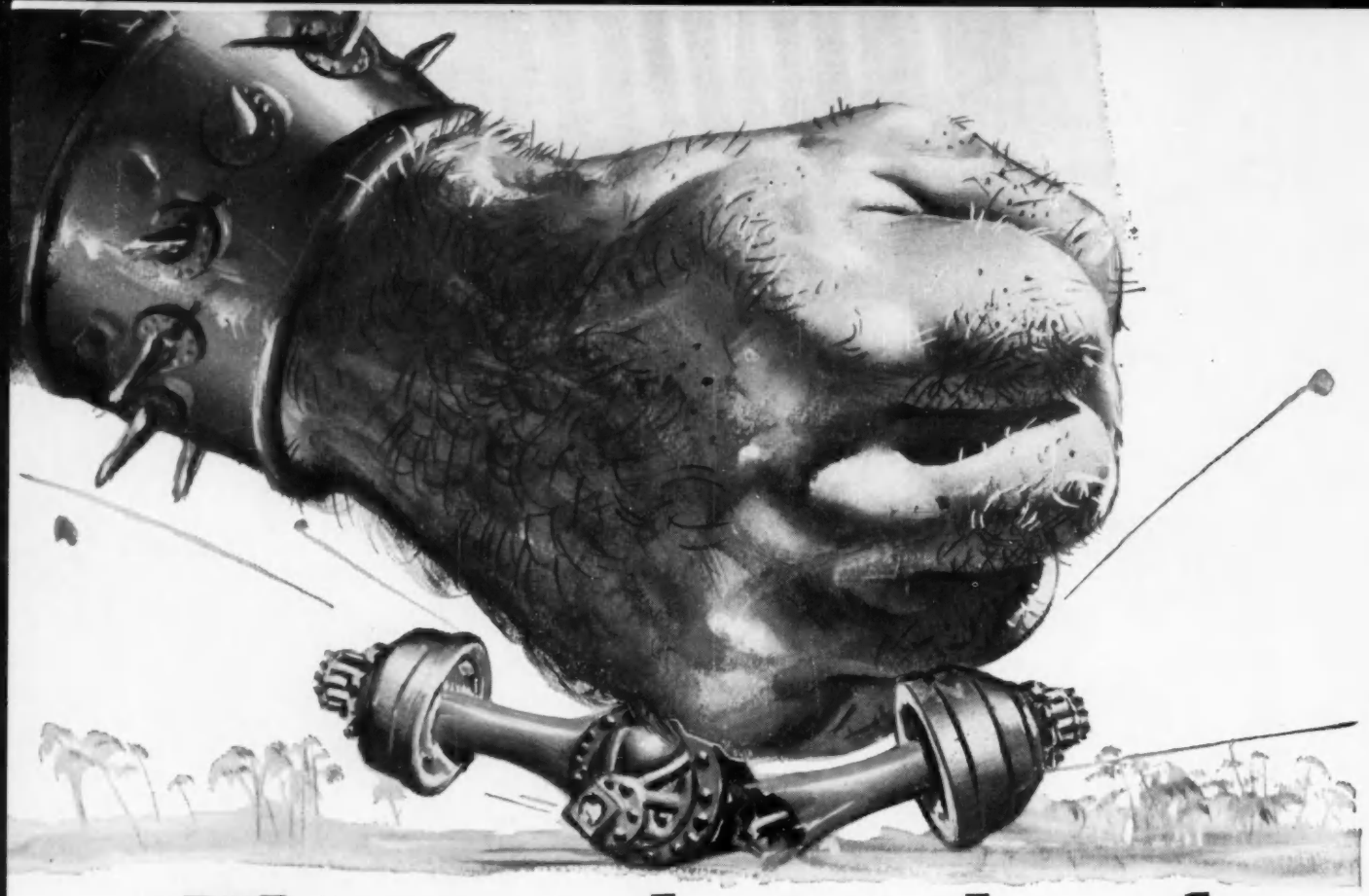
As you know, we have been using your Isomode mounts for quite a few years in the underfloor installation of our amidship motor coach engines and for our radiator installations. The majority of engines used are Hall-Scott, International Harvester and Cummins diesel. Consistent with our policy of selecting only the finest materials available, we chose your Isomode mounts. Our subsequent experience with them has indicated they are more than satisfactory. They are tough and durable, yet absorb vibration to a remarkable degree.

Our policy of maintaining top quality has resulted in our present position as the Nation's largest producer of transit type school buses, and we also build many Airporter, Sightseeing, and Intercity coaches. The quality of your product has contributed materially to the wide acceptance of our motor coaches.

the MB manufacturing company, inc.

1060 State Street, New Haven 11, Conn.

HEADQUARTERS FOR PRODUCTS TO *ISOLATE* VIBRATION...TO *EXCITE* IT...TO *MEASURE* IT



We smash truck axles

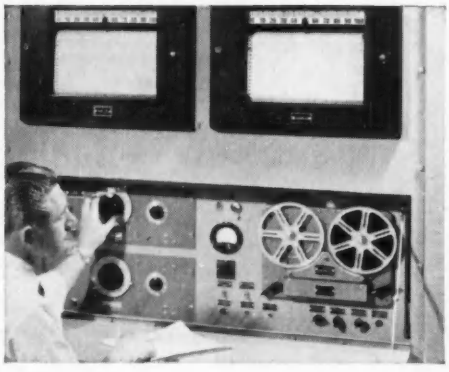
in the new Timken-Detroit indoor proving ground ...and only Timken has it!

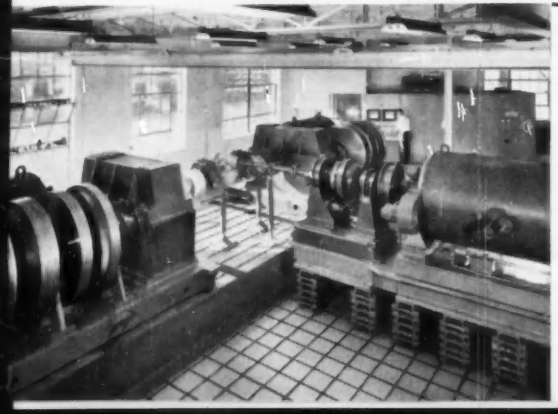
We shock-load, abuse, and torture them. Match every conceivable hauling condition. Then add a few brutal tricks of our own!

Why? So you'll know in advance, and *for sure*, that a Timken-Detroit axle can take the punishment it was designed for. More rugged, grueling punishment than any other axle made!

To prove it, we capsuled a multi-thousand acre proving ground into one room. Here our engineers can put 50 years of experience in building axles for trucks, buses and trailers to work—subjecting axles and gearing *indoors*, to any *outdoor* operating condition.

Such exacting research pays off for you in: longer axle life; less maintenance, repairs and downtime; reduced operating expenses. This is why Timken-Detroit axles are preferred by manufacturers and operators everywhere.





How TDA proves axle quality in this "Torture Chamber"

We pick one of our axles at random . . . then duplicate a hauling condition, hour after hour, day after day . . . simulating half a million miles of the toughest driving situations in just a few days. Or "invent" a test like going uphill with a full load from California to New York nonstop. There is no other axle testing like it in the world!

This is our "truck driver." He works in our "Torture Chamber." Above him are graphs showing speed and torque performance under any operating condition he chooses . . . soft ground at full load . . . mountains . . . express highways or side roads. With special dials, recorders and electronic devices, he actually *drives* the axle with scientific accuracy from his chair!

Far greater gear ratio "spread" with TDA 2-SPEED AXLES,

due to exclusive double-reduction design!

Unequalled Flexibility! Only Timken-Detroit 2-Speed axles are available in *three* different ratio "spreads" to meet any transmission-engine combination: 28%, 37% or 49%. Unlike ordinary designs that are limited to 37%, this Timken-Detroit Axle selection may be obtained simply by changing the low speed helical gear set.

Here's How the TDA 2-Speed Principle Works: A husky hypoid ring gear and bigger, stronger pinion set (No. 1 in illustration below) provides the *first step* of the total gear reduction for both fast and slow ratios. Two large, heavy-duty helical gear sets provide the *second step*. Both sets are of balanced size and capacity. One set (No. 2 in illustration below) is for fast speed—the other (No. 3) is for slow speed. The clutch collar (No. 4 in illustration) moves to left or right to engage one helical pinion or the other.

The Result: Complete elimination of small, complicated parts and midget-size gears! Larger hypoid-helical design gives more teeth in contact—reducing load per unit of contact area—for more positive, quiet operation. Bearings are larger. There's longer engine and truck life. When you divide the total gear reduction, you double its life expectancy. The helical pinion not in use idles. TDA gears operate in any ratio *indefinitely* without overheating.

to bits

TIMKEN Detroit AXLES

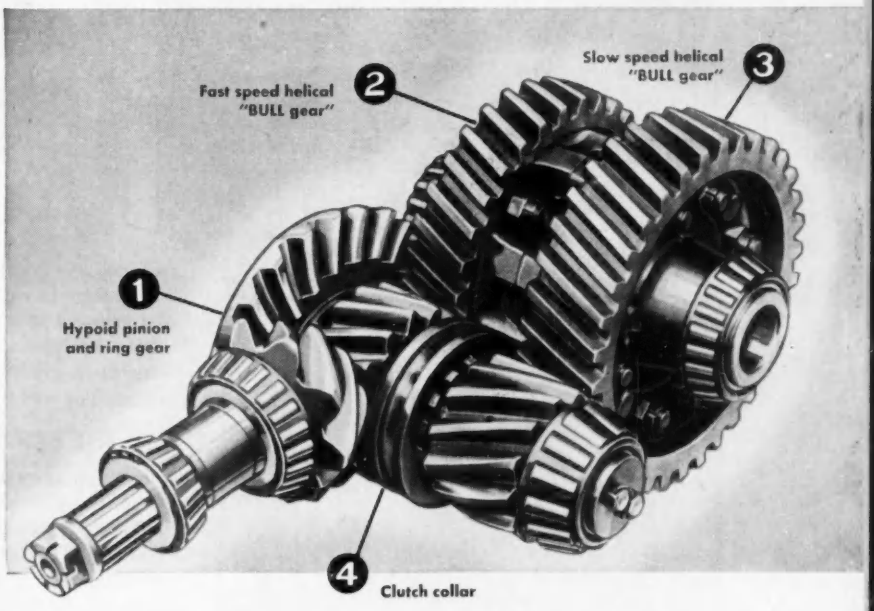
TIMKEN-DETROIT AXLE DIVISION
ROCKWELL SPRING AND AXLE COMPANY
DETROIT 32, MICHIGAN

The Accepted TDA Standard
TRADE MARK REGISTERED

"TORTURE-TESTED"
to Save Money on the Job

WORLD'S LARGEST MANUFACTURERS OF AXLES FOR TRUCKS, BUSES AND TRAILERS

Plants at:
Detroit, Michigan
Oshkosh, Wisconsin • Utica, New York
Ashtabula, Kenton and Newark, Ohio
New Castle, Pennsylvania



7 basic axle capacities! Only TDA, world's largest manufacturers of truck, bus and trailer axles, offers a family of 7 basic axle capacities, each with *interchangeable* final drives: single-speed single-reduction—single-speed double-reduction—two-speed double-reduction—using the same axle shafts and housing. Nowhere is there such a selection to fit all needs.

Exclusive "Torsion-Flow" shafts! Forged so that grain structure of steel conforms to shaft profile, thus assuring uniform distribution of stresses. Exclusive heat-treating formula provides a resilient axle shaft core graduated to a tough, hard outer surface—the ideal combination for axle shaft life. And TDA "Torsion-Flow" shafts are guaranteed for 100,000 miles or 3 years—whichever occurs first.

Hot-forged steel housings! Pound for pound the strongest, most rigid ever built! Rectangular TDA housing shape gives maximum strength, uniform stress distribution, minimum weight. Ask about the TDA "Life of Vehicle" guarantee.

7,000 ITEMS A KEY TO K&E LEADERSHIP

Drafting, Reproduction, Surveying,
Optical Tooling Equipment and Materials
Slide Rules Measuring Tapes

• Since 1867 engineers, scientists, designers, surveyors, draftsmen have relied on K&E as the foremost, most progressive, and most complete source of supply for the tools, equipment, and materials they work with. When you buy, think first of K&E, headquarters for 7,000 items. For example . . .

THE PARAGON® DRAFTING MACHINE

Thorough knowledge and thorough care of minutest detail were essential to the designing of the sturdy, accurate Paragon® Drafting Machine. Draftsmen prefer the Paragon, because it is time-saving and work-sparing, because it is reliable, easy to operate, and because they don't have to treat it with kid gloves. The Paragon Drafting Machine increases drafting room efficiency enormously, and effects substantial economies.

KEUFFEL & ESSER CO.
EST. 1867
New York • Hoboken, N. J.
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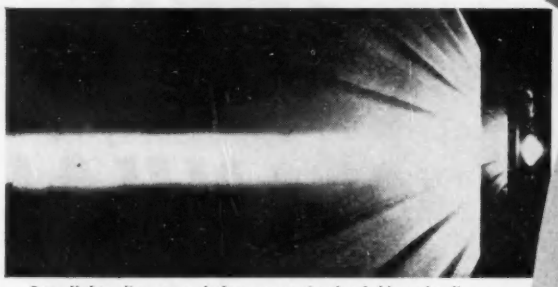
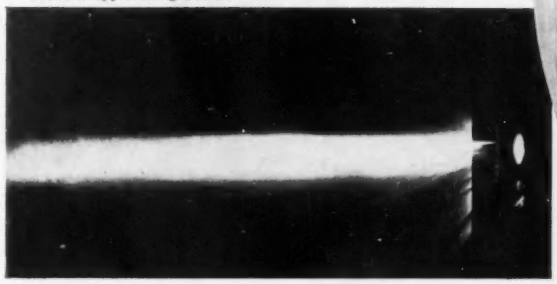
New TUNG-SOL All-Glass Sealed Beam VISION-AID HEADLAMP

IMPROVED BEAM PROVIDES BETTER VISIBILITY



Stray light radiates strongly from conventional sealed beam headlamps. This uncontrolled light reflected back from fog, rain, snow or dust, blocks visibility in bad weather.

Vision-Aid Headlamp emits little stray light—almost none above the useful beam level—improves visibility in bad weather. The light appears cooler to approaching drivers.



VISION–AID HEADLAMP is the most powerful and safest headlamp ever developed. Light output has been increased by raising the lower beam wattage from 35 to 40 and the upper beam from 45 to 50 watts.

VISION–AID HEADLAMP provides 23 percent more light on the low beam and 26 percent more light on the high beam.

VISION–AID HEADLAMP projects the passing beam up to 80 feet farther ahead, but more to the right, at the same time reducing the amount of light directed toward an approaching vehicle.

VISION–AID HEADLAMP produces less uncontrolled light, thereby reducing the light reflected back at the driver from fog, rain, dust or snow encountered in bad weather.

TUNG-SOL ELECTRIC INC., Newark 4, N. J.

Sales Offices: Atlanta, Chicago, Columbus, Culver City (Los Angeles), Dallas, Denver, Detroit, Newark, Philadelphia, Seattle.

Tung-Sol makes All-Glass Sealed Beam Lamps, Signal Flashers, Picture Tubes, Radio, TV and Special Purpose Electron Tubes and Semiconductor Products.

TWO TYPES
5040 for 6 volts, 5400 for 12 volts

SAE offers the...

SHOT PEENING MANUAL

SP-84

● A "HOW-TO-USE-IT" BOOK—
SAE Shot Peening Manual, the work of Division XX—Shot Peening, Iron & Steel Technical Committee, instructs engineers, designers, and shop men in shot peening "know how."

● A FIRST COMPLETE STORY—
the Manual fully discusses shot, shot peening machines, production procedures and process specifications; includes 29 illustrations and a bibliography of 50 selected references.

● A BRAND NEW SAE MANUAL—
the Shot Peening Manual—SP-84, newly listed with our publications, is priced at $2.00 per copy to SAE members and $4.00 per copy to nonmembers; quantity prices upon request.

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29 West 39th Street
New York, New York

Add 3% city sales tax for deliveries in N. Y. C.

Please send me .... copies of SP-84. (Check) (Cash) (Coupons)

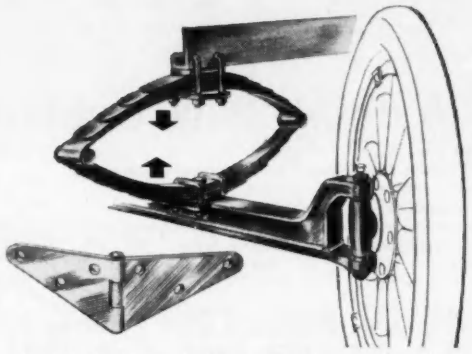
Name _____

Company Name _____

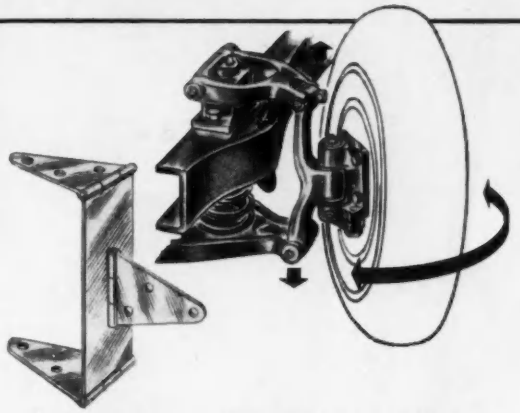
Company Address _____

If your car has Thompson Products ball joints

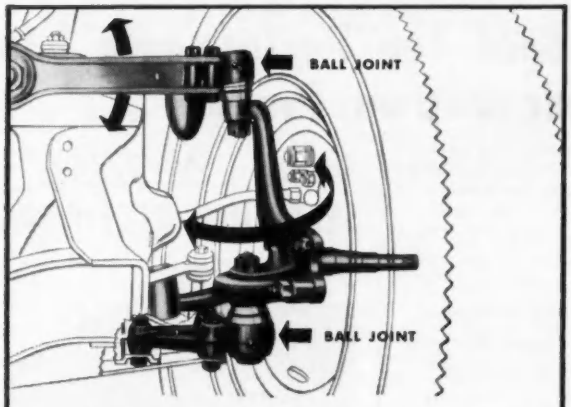
IT WILL HUG THE ROAD BETTER, STEER EASIER, RIDE SMOOTHER AND REQUIRE LESS SERVICING. HERE'S THE STORY:



On Early Cars the front wheels turned right or left as though they operated on door hinges. The entire axle moved up and down stiffly, both springs absorbing all shocks. Later, "knee action" gave each wheel its own springing action, but this greatly complicated the steering mechanism.



The Next Step retained the "hinge" principle, but the coil spring required an *additional* hinge action . . . this time up-and-down. Unfortunately, this meant more points of friction . . . more wear . . . more joints to become loose . . . more points to lubricate . . . and required very accurate alignment.



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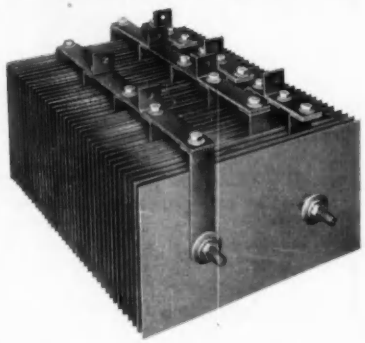

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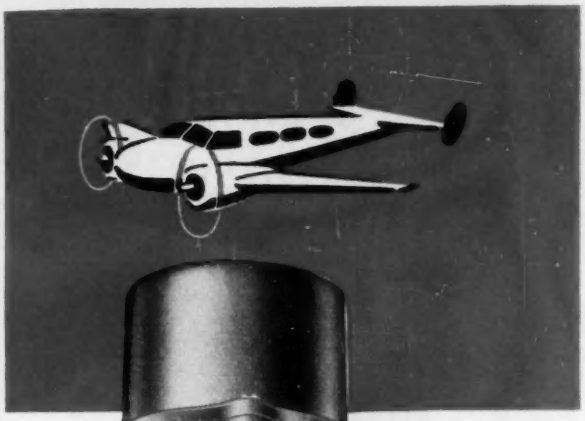

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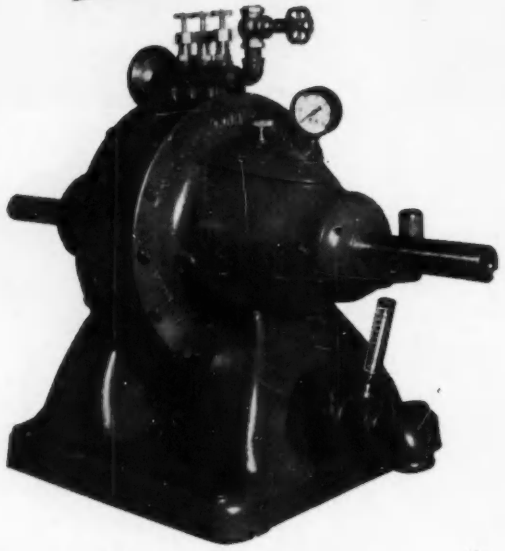

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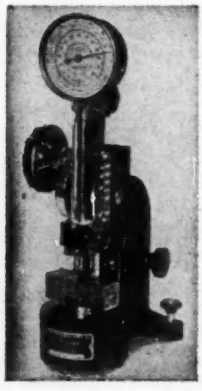

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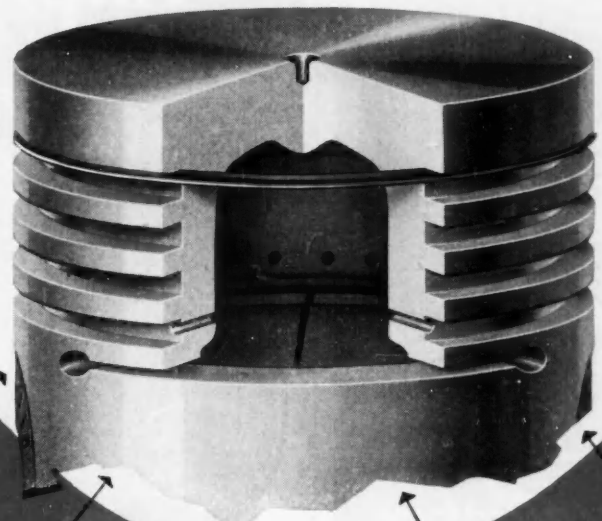

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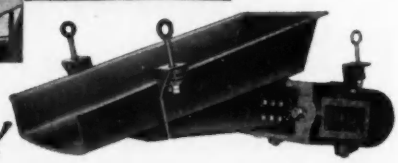

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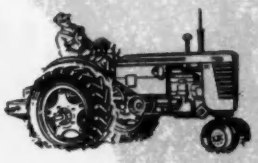

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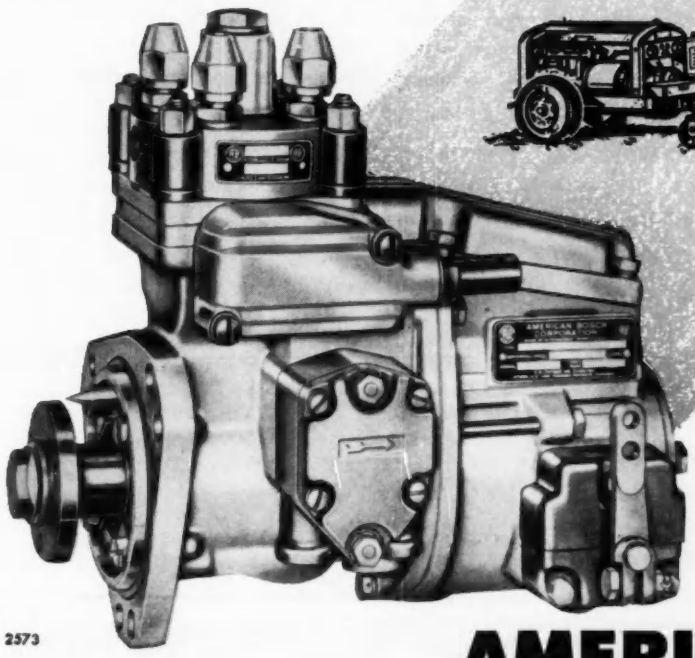

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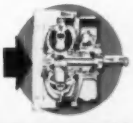

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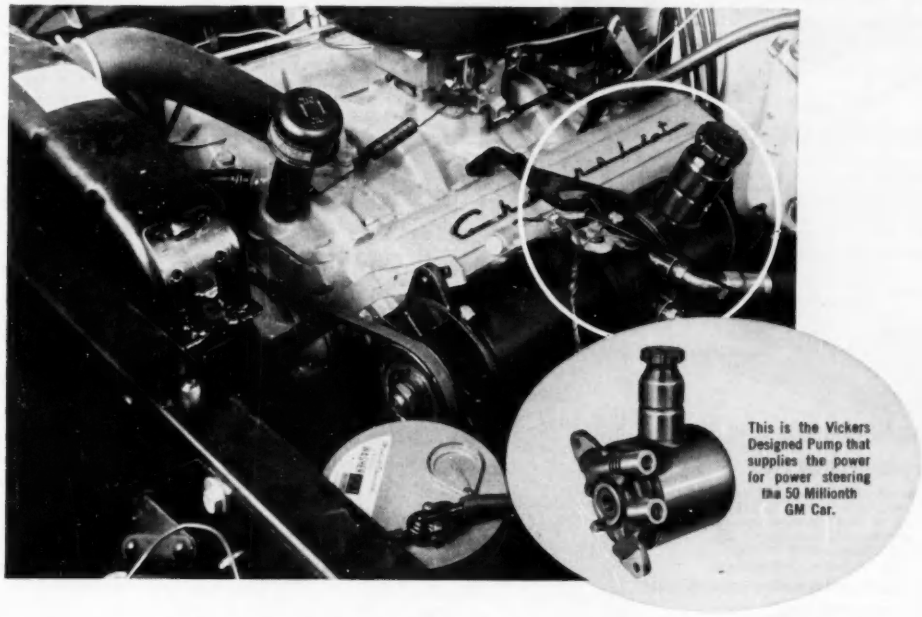

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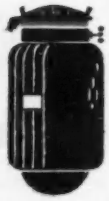
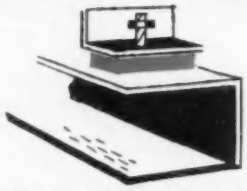


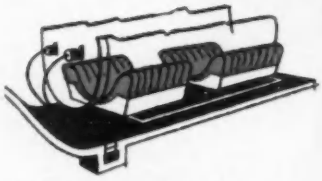
FELT for GASKETS (1)

There has to be a seal between the lid and body of electric power transformers, to exclude dirt and moisture, hold in the oil that insulates and cools. Felt is widely used for this purpose.



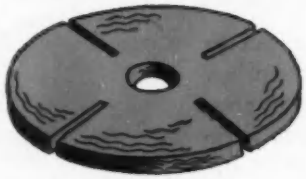
FELT absorbs VIBRATION (2)

To isolate spring-suspended gasoline tanks from the chassis of trucks and absorb road shocks and weaving strains, felt pads are used. These give enough to protect the tanks, but not enough to disturb gas lines.



FELT for LUBRICATION (3)

Many locomotive journals are lubricated by felt, cut to fit the hub. Pumped oil is fed evenly, waste-grabbing eliminated. Length of life of the felt is estimated at 75,000 to 100,000 miles of perfect lubrication.



FELT for POLISHING (4)

The final polishing operation on steel cutlery changes the finish from dull to bright. About .002" of steel is removed by felt polishing discs, fed with fine pumice. The discs are slotted for flexibility.

FELT in REFRIGERATION (5)

In refrigerators and air conditioners there is usually a cartridge filled with a dehydrating agent. Felt is used as a filter to prevent small particles of the drying crystals being carried into the refrigerant line.

GET THE FACTS ABOUT

FELT

AND WHAT IT CAN DO FOR YOU

These are just a few of the many applications of felt in plants and products. Remember that felt is an engineering material, which can be specified as closely as any other. American makes felts as soft as a kitten's ear, or hard as a board, and many other types as well, including OilFoil seals, laminations of synthetic rubber and felt. We also cut felt parts in many shapes, designs and sizes to your blueprints. The Engineering and Research Laboratory will gladly collaborate with you on the selection of the correct felt for maximum economy and satisfaction. Mail the coupon below for further information.

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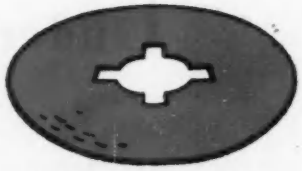
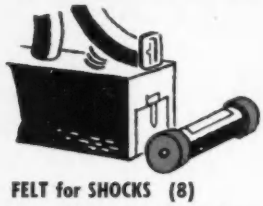


FELT CLUTCH FACING (6)

Industrial sewing machines have a clutch, which must take hold quickly, yet smoothly and firmly. These clutches operate properly when faced with felt discs cut to size and shape. This is a frictional application of felt.

FELT for HONING (7)

The cylinders of internal combustion engines are finished by honing. The honing head carries abrasive stones alternated with strips of felt, the latter greatly improving the quality of the surface obtained.



FELT for SHOCKS (8)

Pneumatic carriers of both large and small sizes are in wide use. American supplies special felts for them. One type is used as a bumper head on the carrier to absorb shock on delivery; another is an air-pressure seal.

FELT for FIRE EXTINGUISHERS (9)

Hand-pumped fire extinguishers use felt washers for lubrication, for holding compression, as a bumper for the upstroke, and as a cushion for the nozzle. American also supplies flame-proofed felt for airplanes, theatres, etc.

AMERICAN FELT COMPANY
P. O. Box 5, Glenville, Conn.

1 2 3 4 5 6 7 8 9

Please send me further information about the application circled above.

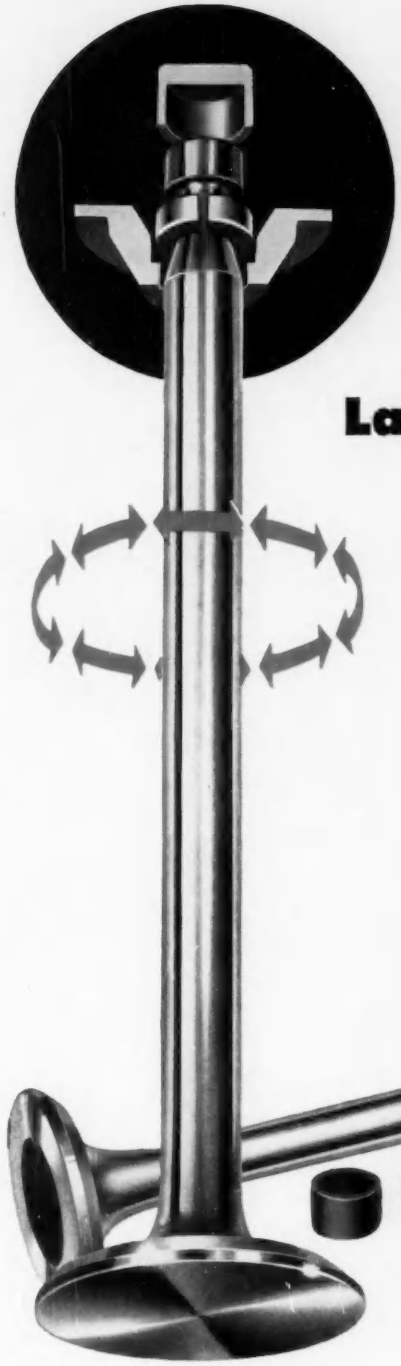
NAME.....

TITLE.....

FIRM.....

STREET.....

CITY.....ZONE.....STATE.....



Eaton Free-Valves

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Freedom to Turn in Either Direction—

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Eaton Free Valves can be applied to engines of all types and sizes without costly design changes.

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Makes soft jobs out of tough nuts

AFTER hundreds of flight hours, the propeller retaining nut that holds an airplane propeller on its shaft often "freezes". Loosening it used to be an hours-long job. Hand wrenches were ruined in the process. Sometimes the nut had to be cut off.

Then someone thought up a hydraulic propeller retaining nut torque wrench. It enabled one man to apply as much as 5,000 pounds feet of torque on the nut—10 times the force he could exert with a 3-foot bar.

But the problem was to develop a wrench socket that would stand up under this pressure. In service, the socket was apt to break or twist out of shape. During the necessary heat treating, it often became distorted and had to be scrapped.

Kell-Strom Tool Company, Inc., of Weathersfield, Connecticut, manufacturers of aircraft propeller tools, took the problem to metallurgists of the Timken Company. After careful study it was recommended that the socket be made from 52100—a Timken® fine alloy steel.

Kell-Strom tried it, found that sockets made from Timken 52100 steel tubing greatly increased the life of the tool. There was less breakage or twisting out of shape. Because 52100 could be heat treated before machining, distortion and scrap were reduced to a minimum. In addition, the splines of the socket were easier to machine than with the steel previously used.

This is only one of the many tough problems stamped "Solved—by Timken Alloy Steel". If you have any tough nuts that need cracking, why not let us help you. Write The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO". Tapered Roller Bearings, Alloy Steel and Seamless Tubing, Removable Rock Bits.